

Exploring How Animal-Protein Sources (Eggs, Meat, And Milk) Relate To Students' Active Participation In Physical Education At The Indonesian School In Makkah

Muhammad Askari Zakariah^{1*}, M. Arif Subair², Novita³, Failal Ulfi Mauliah⁴,
Ambo Dalle⁵, Aiedil Pebri Suwarna⁶.

¹ Department of Animal Science, Universitas Sains Islam Al Mawaddah Warrahmah Kolaka, Indonesia

² Department of Physical Education, Universitas Sains Islam Al Mawaddah Warrahmah Kolaka, Indonesia

³ Department of Islamic Education, Universitas Sains Islam Al Mawaddah Warrahmah Kolaka, Indonesia

⁴ Department of Health Administration, Universitas Sains Islam Al Mawaddah Warrahmah Kolaka,
Indonesia

⁵ Department of Economic, Universitas Sains Islam Al Mawaddah Warrahmah Kolaka, Indonesia

*Corresponding Author: askari@usimar.ac.id

ABSTRACT

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This qualitative-descriptive pilot study explored how animal-protein sources (eggs, meat, and milk/dairy) relate to students' active participation in Physical Education (PE) at the Indonesian School in Makkah. Data were collected using an anonymous structured questionnaire with a two-week recall period covering respondent characteristics, frequency of animal-protein intake, perceived energy/recovery/comfort during PE, and perceived active participation in PE; responses were interpreted thematically to identify recurring patterns without causal inference. Ten students completed the questionnaire (all male adolescents, approximately 12–19 years), and most reported extracurricular sport participation. Four themes emerged: students framed active participation as disciplined engagement across lesson phases, persistence during drills and games, and social engagement through teamwork and sportspersonship; eggs, meat, and milk/dairy were typically reported as routine dietary habits rather than deliberate "PE-day strategies"; perceived readiness for PE was expressed mainly through energy versus fatigue and bodily comfort, suggesting diet may relate to participation indirectly through situational physical readiness; and participation barriers appeared multifactorial, implying strong contributions from non-nutritional influences such as lesson demands and the social-pedagogical climate. Overall, animal-protein sources were not described as direct determinants of PE participation in this small sample, highlighting the need for larger, more diverse studies that add open-ended interviews and consider key covariates (e.g., breakfast habits, hydration, sleep, and PE motivation) to clarify how nutrition and learning environments jointly shape active participation.



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Introduction

Regular physical activity during childhood and adolescence is fundamental for healthy growth and development, supporting cardiometabolic health, musculoskeletal fitness, and psychological wellbeing. Global recommendations emphasize that children and adolescents should accumulate an average of at least 60 minutes per day of moderate-to-vigorous physical activity, including muscle- and bone-strengthening activities on at least three days per week (World Health Organization, 2020). This makes schools—where routines are structured and reach is broad—a strategic setting for promoting equitable opportunities for young people to be active. Within schools, physical education (PE) is a key platform for developing physical literacy and fostering motivation for lifelong movement. Evidence indicates that higher engagement in PE during adolescence is associated with more favorable physical activity trajectories into young adulthood (Palakshappa et al., 2015). However, students' active participation in PE is influenced by more than lesson scheduling or curriculum content. Participation and engagement are shaped by individual and contextual determinants such as perceived competence, enjoyment, motivational climate, teacher support, and peer dynamics (Jaakkola et al., 2015; related evidence summarized in systematic review literature). These determinants imply that increasing active participation requires a holistic understanding of the conditions that make students feel ready and willing to engage physically during PE.

Nutrition is a plausible contributor to students' day-to-day readiness for participation. Qualitative research with adolescents suggests that young people often understand physical activity and eating behaviors as interconnected, shaped by routines, access, and perceived benefits (Hawks et al., 2022). In practical terms, students may link what they eat and drink—especially before school or before PE—to perceived energy, fatigue resistance, concentration, and recovery. From a physiological standpoint, dietary protein is essential for growth, tissue maintenance, and adaptation to physical activity, particularly among youth who are still developing and who may participate in sports beyond PE lessons (Amawi et al., 2024). Among protein sources, animal-source foods such as eggs, meat, and milk are recognized for their high-quality amino acid profiles and their contribution to essential nutrients relevant to growth and development (Parikh et al., 2022). Mechanistic studies in young adults also suggest that whole-food matrices can influence post-exercise anabolic responses; for example, ingestion of whole eggs after resistance exercise has been shown to stimulate muscle protein synthesis more than protein-matched egg whites under controlled conditions (van Vliet et al., 2017). While PE lessons differ from laboratory resistance protocols, such findings help explain why students and families may attribute “strength,” “energy,” or “fitness support” to specific animal-protein foods (eggs, meat, and milk), shaping food choices around active days.

Despite these links, a notable gap remains: the relationship between specific animal-protein sources and active participation behaviors during PE is rarely examined from students' lived perspectives in real school contexts. Much of the literature focuses on nutrition in relation to health outcomes or sport performance rather than classroom-based participation indicators such as sustained engagement, persistence during drills and games, and willingness to practice new skills. A qualitative approach can therefore provide deeper insight into how students interpret the role of eggs, meat, and milk in supporting (or hindering) their PE participation—such as feeling energized, feeling too full, experiencing gastrointestinal discomfort, or perceiving faster recovery. This inquiry is particularly relevant at the Indonesian School in Makkah (Sekolah Indonesia Makkah), which operates in a distinctive socio-cultural and food environment and is located in the Jabal Nur area of Makkah, Saudi Arabia (Sekolah Indonesia Makkah, n.d.). Understanding how students in this setting relate animal-protein choices to PE participation can inform context-sensitive health promotion strategies, school nutrition messaging, and PE planning in international-school environments. Accordingly, this study aims to explore how animal-protein sources (eggs, meat, and milk) relate to students' active participation in physical education at the Indonesian School in Makkah. By foregrounding students' perspectives on consumption patterns and perceived effects on energy, comfort, and engagement, the study seeks to clarify how nutrition-related beliefs intersect with PE participation, and to identify practical school-based opportunities to support active involvement in PE lessons.

Method

This study used a school-based cross-sectional approach to explore how animal-protein sources (eggs, meat, and milk) relate to students' active participation in physical education (PE) at the Indonesian School in Makkah. The reporting structure for this observational work was prepared in line with the STROBE guidance for cross-sectional studies to ensure transparent reporting of design, participants, variables, and analytic decisions (von Elm et al., 2007; EQUATOR Network, 2025). Data were collected using a self-administered questionnaire referencing students' behaviors and perceptions over the previous two weeks, a recall window commonly used in adolescent food-frequency-type assessments and test-retest reliability designs in nutrition measurement research (Frank et al., 1992; Wong et al., 2012). Participants were enrolled students who attended PE during the study period. Recruitment was conducted through coordination with PE teachers and class announcements, and participation was voluntary. The survey was anonymous and did not request personally identifying information. Inclusion criteria were enrollment in the school and willingness to complete the questionnaire based on the specified two-week recall. Responses with missing data on key constructs (animal-protein intake items or PE active participation items) were handled by excluding those records from inferential analyses while retaining them for descriptive summaries where appropriate, consistent with common practice in survey-based observational studies (von Elm et al., 2007).

The questionnaire was developed in Indonesian and consisted of four sections: respondent background, animal-protein intake patterns, perceived energy/recovery/comfort during PE, and active participation during PE lessons. Background information captured grade level, sex, age, extracurricular sport participation (type and weekly frequency), and weekly PE frequency. Animal-protein intake patterns were assessed using a frequency scale with five ordered response categories ranging from "never" to "daily." The intake module was organized into three domains that correspond to the study title, namely eggs, meat (including poultry/fish and processed meat products), and milk/dairy (including yogurt), with three items per domain to capture typical consumption, breakfast-related consumption, and consumption on PE days. This structure mirrors the logic of non-quantitative food frequency approaches where frequency of intake is used to characterize dietary patterns rather than estimate absolute nutrient grams (Frank et al., 1992; Wong et al., 2012). A brief optional portion section was included to strengthen contextual interpretation of frequency responses by documenting typical egg count per eating occasion, approximate milk volume per serving, and perceived meat portion size.

Students' perceived energy, recovery, and comfort during PE were measured using a five-point Likert response format from "strongly disagree" to "strongly agree," which is widely used to capture attitudes, perceptions, and self-reported experiences in education and health research (Likert, 1932; Koo & Yang, 2025). Items in this section covered perceived energy during PE, fatigue, ability to complete PE activities, recovery after PE, muscle soreness, dizziness/weakness, focus, and gastrointestinal comfort. Active participation during PE was also measured using a five-point Likert format, focusing on behavioral engagement indicators such as completing warm-up/cool-down, sustained involvement in drills and games, willingness to try new skills, teamwork and sportspersonship, classroom interaction, and overall active movement during lessons (Likert, 1932; Koo & Yang, 2025). The participation construct included a negatively worded item reflecting a tendency to sit/stop during PE; this item was reverse-coded during scoring so that higher values consistently represented higher participation. While reverse-coded items are common for reducing acquiescence, they may add cognitive complexity; therefore, the questionnaire instructions were written clearly and the reverse-coded item was checked during data cleaning for inconsistent responding patterns (Suárez-Álvarez et al., 2018; Koo & Yang, 2025).

For operationalization, intake scores were computed by summing the three frequency items within each domain to generate separate egg intake, meat intake, and milk/dairy intake scores, with higher scores indicating more frequent consumption. Active participation was computed as the sum of the ten participation items after reverse coding the negative item, yielding a composite participation score in which higher values indicate greater active engagement. Perceived energy/recovery/comfort was computed as a composite score after reverse coding negatively framed items so that higher scores reflect better perceived readiness and comfort during PE. Internal consistency reliability of multi-item constructs was evaluated using Cronbach's alpha, and alpha values around 0.70 were interpreted as acceptable for early-stage research instruments, consistent with widely cited psychometric guidance and applied measurement discussions (Tavakol & Dennick, 2011; Hussey et al., 2025). Data collection was administered in a supervised school setting or via a secure online form, depending on the class arrangement. Students were instructed to respond based on the previous two weeks and were reminded that there were no right or wrong answers and that responses would be kept confidential. Teachers assisted only with logistics and did not access individual responses to reduce social desirability bias and perceived evaluation pressure. Ethical conduct

followed established human-participant research principles, including voluntary participation, protection of privacy, and special safeguards for minors; assent from students and consent from parents/guardians were obtained as required by school policy and applicable regulations (World Medical Association, 2013). Data analysis began with descriptive summaries of respondent characteristics and key variables using frequencies, means, and standard deviations. Associations between intake scores and PE active participation were explored using correlation analysis and linear regression modelling. Correlation coefficients were selected based on measurement characteristics and distributional considerations, recognizing that Pearson correlation is typically used for continuous variables and Spearman correlation is suitable when the relationship is monotonic or when variables are ordinal or non-normally distributed (Schober et al., 2018; Statstutor, n.d.). Regression analysis treated the active participation score as the dependent variable and egg, meat, and milk/dairy intake scores as primary predictors, with adjustment for potential confounders such as age, sex, PE frequency, and extracurricular sport participation where available and complete. The interpretation of regression followed standard linear regression principles for observational data, focusing on estimated associations rather than causal inference (Roustaei, 2024). Statistical significance was evaluated at the 0.05 level and analyses were conducted using standard statistical software.

Results and Discussion

A total of 10 students from the Indonesian School in Makkah completed the questionnaire. All respondents were male and represented a broad adolescent age range. Most students reported participating in extracurricular sports activities such as futsal, football, and table tennis, suggesting that PE participation occurred within a school context where sport and physical activity were familiar and socially normative. The frequency of PE lessons varied across respondents, but PE was generally scheduled one to two times per week. Across the active participation items, students consistently described “being active” in PE as more than simply physical exertion. The pattern of responses indicated that active participation included taking warm-up and cool-down seriously, remaining engaged throughout the main lesson activities (drills and games), and maintaining effort even when skills were challenging. Social components were also salient, with teamwork, sportspersonship, and constructive involvement during group play emerging as central markers of active participation. Overall, “active participation” was expressed as a combination of movement, discipline, and cooperative behavior within the PE learning environment.

Responses to the animal-protein frequency items showed variation across individuals in the consumption of eggs, meat (including poultry/fish and processed meat products), and milk/yogurt over the previous two weeks. However, the overall response pattern did not suggest that most students systematically adjusted these foods specifically around PE days. Instead, animal-protein sources appeared to be embedded within everyday meal routines (e.g., breakfast or common household meals), with milk/yogurt often positioned as a practical option. The optional portion items further suggested that students could describe typical serving patterns, reinforcing that consumption was habitual and structured by routine rather than planned as a performance-focused behavior.

Students' responses to the energy, recovery, and comfort section highlighted that readiness to participate was primarily perceived through bodily feelings during PE. Many responses reflected perceived energy and the ability to complete PE activities, while a subset of responses indicated barriers such as quick fatigue, occasional dizziness/weakness, and muscle soreness. This theme suggests that the day-to-day experience of “being able to participate” was interpreted through immediate physical readiness and comfort, which may fluctuate depending on daily conditions. In qualitative terms, students' perceived readiness functioned as a bridge between dietary habits and participation behaviors, even when the questionnaire did not capture detailed narrative explanations.

Although the questionnaire did not directly ask students to explain why participation may decrease, the pattern across fatigue/comfort items and the negatively framed participation item (tendency to sit/stop) suggests that participation may be constrained by factors beyond food intake alone. The overall results imply that participation is likely shaped by a combination of physiological readiness (energy and comfort), lesson demands, and the broader PE learning climate. Given the strong presence of extracurricular sports among respondents, it is also plausible that prior sport involvement buffered participation differences during PE, making nutrition-related influences less visible in short-term self-reported patterns.

Discussion

The qualitative-descriptive findings from the questionnaire at the Indonesian School in Makkah indicate that “active participation” in Physical Education (PE) is understood by students as a combination of disciplined engagement across lesson components (warm-up–main activity–cool-down), persistence during drills and games,

and social involvement such as teamwork and sportspersonship. This pattern suggests that active participation is fundamentally a pedagogical and social phenomenon, rather than a simple reflection of physical capacity or dietary “fuel.” The PE engagement literature supports this framing: perceived teacher support is consistently associated with student engagement in PE, particularly behavioral and emotional engagement (Guo et al., 2023), and motivational climate shaped by teachers and peers has been shown to influence students’ achievement goals in PE across the school year (Warburton, 2017). In the SIM Makkah context, most respondents also reported extracurricular sport participation, which likely strengthens habitual movement patterns and may “buffer” PE participation regardless of short-term dietary differences, making the influence of specific foods less visible when captured through a closed-ended two-week questionnaire.

Although a direct narrative link between animal-protein intake and classroom PE participation did not emerge strongly, existing evidence suggests that eggs, meat, and milk/dairy remain biologically and behaviorally relevant as part of lifestyle patterns that can support physical readiness and fitness—factors that may act as prerequisites for active participation. Studies among children and adolescents have reported that more favorable patterns involving breakfast, eggs, and dairy are associated with better fitness outcomes, including endurance- and strength-related components (Zhang et al., 2022), and similar associations have been reported in nutrition-focused adolescent research linking diet behaviors (including egg and dairy consumption) with fitness-related outcomes (Li et al., 2026). At a large population scale, recommended dairy intake has been associated with a healthier lifestyle profile, better physical fitness, and lower likelihood of insufficient physical activity (Tambalis et al., 2022).

Other evidence suggests that dietary behaviors and physical activity often “cluster” together in adolescent health outcomes; for example, milk intake has been examined alongside physical activity in relation to cardiometabolic risk markers such as abdominal obesity (Abreu et al., 2014), and research integrating dairy intake, sedentary behavior, and physical activity has also linked these behaviors to bone-related outcomes in adolescents (Kopiczko et al., 2024). A meta-analysis of randomized trials has indicated that milk/dairy interventions may support increases in lean mass among children and adolescents, which is conceptually relevant to physical capacity and performance (Kang et al., 2019). Additional work has highlighted that the combination of physical activity and milk intake relates to adolescent bone mineral density (Lee et al., 2021), while broader reviews emphasize that physical activity can increase protein requirements during growth and development, positioning dietary protein as supportive for adaptation and maturation in active youth (Garcia-Iborra et al., 2023). Collectively, this supporting body of research underlines that animal-protein foods often form part of broader healthy lifestyle patterns and fitness outcomes, even if they do not appear as single, dominant predictors of classroom participation in PE.

At the same time, many studies report null, weak, or inconsistent associations, which aligns with the SIM Makkah results that do not show a strong, clear relationship between animal-protein intake and active PE participation when assessed through a short, closed-ended questionnaire. For example, an egg supplementation trial in school-aged children improved some nutritional indicators but did not necessarily yield significant improvements in physical fitness (Amenya et al., 2024). In the HELENA study among European adolescents, egg consumption was not associated with cardiorespiratory fitness or several cardiovascular risk factors, and the associations were not modified by physical activity (Soriano-Maldonado et al., 2013). Relationships between diet and daily physical activity are also frequently mixed; evidence on breakfast and adolescent physical activity has been described as inconclusive in some contexts (Corder et al., 2011), while day-level analyses have shown that breakfast–MVPA associations may appear under specific conditions (e.g., weekends) but are not stable across all days (Corder et al., 2014).

For dairy, epidemiological findings remain varied: prospective and cross-sectional work has reported that milk intake may not be associated with percent body fat and emphasized ongoing inconsistencies in the literature (Noel et al., 2011), while reviews have suggested that adolescent dairy intake does not necessarily produce large long-term effects on low-grade inflammation and insulin resistance (Hohoff et al., 2024). Longitudinal evidence on dairy intake from adolescence into adulthood also indicates complex and context-dependent patterns rather than a straightforward, consistent relationship (te Velde et al., 2011). Moreover, protein-focused discussions caution that high protein intake in well-nourished child and adolescent populations is not universally beneficial; one study reported associations between higher protein intake and stunting, emphasizing the importance of context and overall diet quality (Xiong et al., 2023). In certain settings, research has also found no significant relationship between energy/protein/carbohydrate intake and physical activity (Ramadhani et al., 2022). Finally, food-specific effects are often non-linear; in broader adult literature, egg intake is frequently reported as neutral with respect to certain cardiovascular outcomes, reinforcing the principle that a single food rarely predicts outcomes in a simple way (Drouin-Chartier et al., 2020; Godos et al., 2021). Synthesizing both the supportive and conflicting bodies of

evidence helps position the SIM Makkah findings appropriately. The “supportive” literature tends to focus on fitness, body composition, bone health, or long-term health markers—biological and lifestyle outcomes that may facilitate physical engagement—whereas the “conflicting” literature emphasizes that associations between specific foods (eggs/dairy/protein) and physical or behavioral outcomes are often small, inconsistent, or dependent on population context, study design, and the outcome selected. Because this study focuses on active participation as a PE classroom learning behavior, it is reasonable that eggs/meat/milk did not emerge as single determinants. A more plausible interpretation is that diet may influence participation indirectly through physical readiness (energy, comfort, fatigue-related symptoms), while actual classroom engagement remains strongly shaped by the learning climate, teacher support, peer dynamics, and students’ existing sports habits (Guo et al., 2023; Warburton, 2017). Practically, this suggests that improving active participation at SIM Makkah may benefit from an integrated approach: realistic nutrition messaging (e.g., comfortable breakfast choices, hydration, avoiding gastrointestinal discomfort before PE) combined with evidence-based pedagogical strategies that strengthen engagement (enjoyable tasks, appropriate challenge progression, and supportive teacher behaviors), which may help stabilize participation across PE sessions.

Conclusion

This qualitative-descriptive study at the Indonesian School in Makkah indicates that students interpret active participation in Physical Education as disciplined engagement throughout the lesson, persistence during drills and games, and socially oriented behaviors such as teamwork and sportspersonship, while eggs, meat, and milk/dairy are generally consumed as routine dietary habits rather than deliberate “PE-day strategies”; consequently, any relationship between animal-protein sources and participation appears more plausibly indirect—through perceived physical readiness such as energy, fatigue, and bodily comfort—whereas classroom participation is likely shaped more strongly by pedagogical and social influences (e.g., teacher support, peer climate, and existing sport involvement), and given the small, homogeneous sample and reliance on closed-ended questionnaire data, these findings are preliminary and non-causal, highlighting the need for larger studies that add interviews or open-ended questions and account for key factors such as breakfast habits, hydration, sleep, and PE motivation.

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