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Original Article

Level of physical activity, eating habits, and their relationship with academic performance in adolescent students at COMEDUC foundation, Chile.

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Abstract:
This study was aimed to determine the impact of the level of physical activity and eating habits in the academic performance of an adolescent school population in Chile. The study has a descriptive cross-cutting design. The sample was formed by 2116 students (60.8% women and 39.2% men), later it was stratified according to level of physical activity and eating habit. Habits were determined by means of a 24-hour reminder, the level of physical activity by means of the International Physical Activity Questionnaire, and the general school averages, mathematics and language, as well as standardized tests were considered. For the analysis of data, descriptive and inferential statistics were used. The results indicated that having a high level of physical activity and having the main meals per day is associated with a better school performance, highlighting the importance of promoting these habits among the school community.
Key Words*:* Physical Activity, Habits, Feeding, Academic Performance

Introduction

This research originates from the need to have information about healthy life habits, specifically on behavioral practices of physical activity and eating habits of Chilean teenage students. In the same way, to know the influence that both behaviors could exert on the academic performance of these students.

In relation to this, we understand for adolescence the "period of growth and human development that occurs after childhood and before adulthood, between the ages of 10 and 19" (WHO, 2016a, p.1).The WHO considers adolescence to be a complex transition stage, and Borrás (2014) considers it a stage of vulnerability. This is how we see characteristics of lifestyle that differ from international recommendations, expressing themselves with a high prevalence of bad eating habits and physical inactivity (Zea, De Souza, Rodríguez and Molina, 2017; Grajales, Villalobos and Guillén, 2018; Voráčová, Badura, Hamrik, Holubčíková and Sigmund, 2018). Therefore, it is important that a healthy lifestyle is promoted from childhood, by the family and schools (Olivares, Rossi, & Bustos, 2018; Restrepo & Gallego, 2010).

"Healthy life habits include health behaviors, behavior patterns, beliefs, knowledge, habits and actions of people to maintain, restore or improve their health" (Sánchez-Ojeda y Luna-Bertos, 2015, p.1911). In this way, we will study the physical activity and eating habits, as considered crucial behaviors in front of the prevention and control of chronic non-communicable diseases (WHO, 2011).

With regard to physical activity, the WHO (2018b) calls for a redoubling of efforts in the face of the growing level of sedentary lifestyle and the promotion health through the Global Action Plan on Physical Activity, stating that three out of four adolescents (between the ages of 11 and 17) currently do not meet the global recommendations for physical activity established by the WHO. The plan proposes a reduction in physical inactivity by 15% by the year 2030, indicating that progress towards the goal must be monitored from physical activity to two groups: adolescents aged 11 to 17 and over 18 years.

The levels of physical activity in the world differ depending on the geographical origin. This is how the European Commission (2014) reports that a 41% of citizens declare a frequency of physical activity of minimum once a week, and a 59% is declared sedentary. For its part, Latin American countries report rates of physical inactivity that exceed 50% of the population, as Argentina with a prevalence of physical inactivity of 54% (MSAL, 2015) or Brazil with a 62.1% (IBGE, 2015).

In Chile, the National Health Survey (MINSAL, 2017) reveals that 86.7% of the general population participated in some physical activity less than three times a week and for a time not exceeding thirty minutes. For the age range between 15 and 19 years, the same condition is expressed in 73.5%, being very far from the

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time of 60 minutes daily of physical activity recommended to this group by the World Health Organization. It also shows that people of low socio-economic level (SEL), have less interest in the practice of physical activity and sports, at the same time they have higher rates of sedentariness, compared to those in higher groups.

In the same way, the last evaluation of the School Physical Condition, developed through the subject of Physical Education and Health by the Chilean Education Quality Agency (2015a), showed a bad physical condition in elementary 8th graders (13 – 14 years), with strong differences between gender, which favor men. Thus, in aerobic endurance, 93% of men have an acceptable condition, compared to 78% in women, or muscle strength where a 41% of men have acceptable condition, while in women this condition is expressed in 31% of them.

In regional studies we observed in an adolescent population that 29.4% are active, corresponding 19.2% to women and 50.9% to men; while a 70.6% are sedentary, being 80.8% women and 49.1% men (Alarcón et al., 2015). Regarding the frequency of physical activity in school adolescents 55% do it 3 or more days per week, 38.1% do it occasionally, while 6.9% never do it (Vergara, Elzel, Ramírez, Castro-López y Cachón, 2015).
Regarding eating habits and the distribution of food consumption per day, it is considered that, in 5 intakes, the approximate caloric distribution would be: 20% breakfast, 10-15% mid-morning, 25-35% lunch, 10-15% mid-afternoon and 25% dinner (Ministryof Health and Consumer Affairs, 2008).In compliance with 4 or 5 intakes per day by the population, Cuervo, Cachón, González and Zagalaz (2017) report that 65% of Spanish population eats 4 or 5 meals a day. While Pi, Vidal, Brassesco, Viola &Aballay(2015) express that 70% of Argentinian population eats4 meals a day. Between these meals, breakfast is part of a healthy diet pattern (López-Sobaler, Cuadrado- Soto, Peral-Suárez, Aparicio and Ortega, 2018).In countries of the European Union, the omission of breakfast averages 32% of the population (Bjornara et al., 2014).In Brazil, it reaches 33.1% (Troncoso, Barbosa De Oliveira, Maria and Sichieri, 2018). While in Chile it averages 25% (Berta, Fugas, Walz and Martinelli, 2015).

In Chile it is reported that 95% of the population does not eat a healthy diet, revealing that those who have a low socioeconomic level have lower intake of vegetables, fruits, low-fat dairy products, meat (white and red), fish and monounsaturated fats (olive oil), in comparison to those who have a high socioeconomic level (MINSAL, 2014). With regard to the school population, the results suggest that, considering the Food Guidelines (Olivares Cortés et al., 2015), there is a general non-compliance with theintake of vegetables and fruits, and especially a low intake of fish and diary products.Through the first study of dairy products consumption habits, in children from 10 to 14 years (ConsorcioLechero, 2018), it is observed that only 39% consumes the recommended daily allowance, corresponding to three servings a day. In relation to this, regular meals would improve the diet of adolescents where the collation, which constitutes approximately 15-20% of the daily calories, is a good opportunity tomanage fruits, dairy products and cereals (Ibarra-López, Llobet-León, & Fernández-Rojas, 2012).

On the other hand, during the school career, there are several instances that seek to develop skills acquisition,by means of didactic instances that interact permanently with the student.Among these, we find the educational evaluation. For Rodríguez (2005) evaluation is “that set of systematic processes for collecting, analyzing and interpreting valid and reliable information, that in comparison to a reference or criterion allows us to reach a decision that favors the improvement of the evaluated object” (p.2). Evaluation of learning outcomes constitutes a systematic observation process that may require measuring based on a mathematical scale the effect of these results. The impact they generate, as well as their full development, will then allowfeedback for the educational systemand the implementation of continuous improvement actions in new learning processes in the future (Yáñez, 2016).

The process allows obtaining learning results, alluding directly to the performance that we can obtain from the efforts developed. The dictionary of the Royal Spanish Academy, RAE (2016) defines performance as “product or utility that yields or gives a person or thing” and in turn as “proportion between the product or the result obtained and the means used”. According to Cascón (2000) academic performance is "an effect of multiple variables that interact with each other, in which the indicator of the educational level acquired, are the school grades” (p.1). Zapata, De los Reyes, Lewis and Barceló (2009) have a more global conception, they consider it as the system that measures the construction of knowledge, cognitive skills and academic competences created by the intervention of strategies and educational didactics that are evaluated through qualitative and quantitative methods in a subject.

For its part, the results of the qualitative and quantitative methods of evaluation are called grades. Onetti (2011)refers to grading as a conduct assessment. The grade will be the qualitative expression (capable – non capable) or quantitative (10, 9, 8, etc.) of the value judgment that we emit on the activity and achievement of a student. In this value judgment you usually want to express the degree of sufficiency or insufficiency, knowledge, skill or ability of the student, as a result of a process.

Physical Activity, Eating Habits and Academic Performance

When analyzing the interrelation between the practice of physical activity and the academic performance, it is considered that those who practice at least 30 minutes of systematic physical activity per day

obtain better school grades than those who do not practice physical activity (Hernández &Portolés, 2016). Similarly, students attending schools with more curricular hours of physical activity are the ones with the best results both in Language and Mathematics.That is to say, dedicate more than 4 hours per week to scheduled exercise significantly increased the chances of achieving adequate results (Correa-Burrows, Burrows, Ibaceta, Orellana, & Ivanovic, 2017). On the other hand, Pellicer-Chenoll et al. (2015), determined that students with more physical activity and a better physical condition, showed a higher academic performance, while adolescents with lower physical activity and low physical condition showed lower academic performance.

For its part, the relationship between eating habits and academic performance has shown that there is an association between the regular consumption of the three main meals, breakfast, lunch and dinner and better academic performance (Kim et al., 2016; Øverby, Lüdemann, &Høigaard, 2013).Also, it is exposed that food consumption that is rich in essential nutrients and with energetic contribution according to the individual necessities, is significantly associated with good academic performance (Kim, Kim y Kang, 2016; Pearce et al., 2018).

Considering physical activity and eating habits as key factors in a healthy lifestyle it becomes necessary to involve and make schools take responsibility for their promotion and development. And not only in childhood, where it is more feasible to find proposals (JUNAEB, 2016; Díaz, Mena, Valdivia, Rodríguez y Cachón, 2015; Vásquez, Carrasco y Martínez, 2015), but to make them extensive to the schoolsfor adolescents and specifically for those of high social vulnerability. So we would increase the chances of having a healthier and more active adult population.

The objective of this research is to determine the impact that the level of physical activity together with the eating habits could have in the academic performance of adolescent students of COMEDUC Foundation, Chile.

Material & methods

Participants

2116 students participated, 1286 women (60.8%) and 830 men (39.2%). All of them belonging to National Trade Foundation for Education, COMEDUC, where Technical and Vocational education is taught. The population comprises students enrolled in grades 1º to 4° High School, between 14 and 18 years as of March 30th, 2017. To select the sample, a simple randomized probabilistic method was used without replacement, and stratified by school level. After analyzing the results of the IPAQ instruments and 24-hour reminder, a new classification was made by Level of Physical Activity (LPA) and Eating Habits. Thus, as we see in table 1, Group 1 was formed by students who presented a high LPA and had meals (breakfast, lunch, dinner, collation and 4 meals a day), while Group 2 was formed by students with low LPA and who did not have the meals (breakfast, lunch, dinner, collation and 4 meals a day)

Table 1:*Conformation of stratified sample by level of physical activity and eating habits.*

Stratification		**Total N**	**Men n (%)**	**Women n (%)**
LPA and breakfast consumption	Group 1	273	159 (58.2)	114 (41.8)
	Group 2	193	49 (21.4)	144 (74.6)
LPA and lunch consumption	Group 1	424	244 (57.5)	180 (42.5)
	Group 2	44	19 (43.2)	25 (56.8)
LPA and dinner consumption	Group 1	391	229 (58.6)	162 (41.4)
	Group 2	55	9 (16.4)	46 (83.6)
LPA and collation consumption	Group 1	251	129 (51.4)	122 (48.6)
	Group 2	171	44 (25.7)	127 (74.3)
LPA andtotal consumption of meals a day	Group 1	157	85 (54.1)	72 (45.9)
	Group 2	254	58 (22.8)	196 (77.2)

Procedure

After the presentation and authorization by COMEDUC to carry out the investigation in its schools, the protocol of Investigation was communicated in meeting of Representatives.Determined and communicated the random sample, each school processedthe informed consents with the parents and subsequently determined the temporality of the application of the instrument, so as not to affect the various academic and institutional activities.The IPAQ and the reminder were applied by means of the digital platform Questionpro, in the computer labs of each school, guided by the teacher who was trained for this activity.Subsequently, academic performance variables were received: standardized test results by level and subject and school averages of the school year 2017.With all supplies we analyzed the results of the IPAQ and the 24-hour reminder, and from these results the sample of this research is stratified.This research is carried out with partial data of the Doctoral thesis of the principal author, and of which other articles have been generated.

Instruments

To carry out this research, the following instruments were used:

- Socio-demographic Questionnaire: To determine the personal characteristics of students, the 2010 SIMCE Evaluation student questionnaire was applied (A. Calidad, 2015b). For this purpose, specific use was made of items that point to identification with respect to gender, school, level, age and region of origin.
- International Physical Activity Questionnaire (IPAQ): The implementation of the IPAQ began in Geneva in 1998 and has been validated in various studies in European, Asian, Australian, African and American populations (Román, Ribas, Ngo and Serra, 2013; Serón et al., 2010),it was also recommended as an instrument to be used for epidemiological vigilance at the population level (Mantilla and Gómez, 2007).The IPAQ was validated in Spain by correlation with pedometer, with a high correlation between both (Bortolozo, Santos, Pilattiand Canteri, 2017).It was also validated in a teenage population aged 14 years and over (Guedes, Lopes and Guedes, 2005; Aibar, García-González, Abarca-Sos, Murillo and Zaragoza, 2016).The IPAQ can be developed in two versions, a long one that consist of 31 questions detailing among other activities, work, home, gardening and leisure time. And a short one that considers the time spent performing physical activities, as well as in sedentary activities (Mantilla et al., 2007).The IPAQ in its short version consists of 7 questions regarding physical activity performed in the last 7 days, as well as walking and sitting time on a working day (Delgado et al., 2005).It can be applied by direct interview, telephone or a surveycompleted on their own.
- 24-hour food reminder: The study of eating habits has been developed through the application of the 24-hour reminder of the National Food Consumption Survey (MINSAL, 2014).The 24-hour reminder lets us know whether or not the 4 main meals of the day are consumed, with dichotomous or multichotomous questions, being:
  - Breakfast: first meal, developed on weekdays between 07:00 and 9:00.
  - Lunch: second meal of the day, developed on weekdays between 13:00 and 15:00.
  - Collation: intake between lunch and dinner, at about 17:00.
  - Dinner: last meal, developed on weekdays between 19:00 and 21:00.
- For the analysis of the academic performance variable, the school averages of Mathematics and Language were used, as well as the General Average of Subjects. The data was requested from COMEDUC Foundation, the administrator of the computer program that registers the database of the schools.This program is linked to the General Student Information System of the Ministry of Education, so its information is registered in the official certificates of the 2017 school year.
- External Standardized Math and Language Evaluation Results. The Learning Assessment Program, developed by entities outside the Foundation, aims to diagnose school students in the face of external national evaluations,either the evaluation of teaching quality, SIMCE (1st and 2nd high school) or the university selection test, PSU (3rd and 4th high school)

Data collection and analysis / Statistical analysis

For descriptive analyses, the information of the different categorical variables has been summarized, using absolute frequencies (n) and relative frequencies (%). In the case of continuous quantitative variables, the mean and standard deviation (SD) have been used. Parametric and nonparametric tests have been used for inferential analysis. Nonparametric tests were used whenthe data did not meet the assumptions of normality and homogeneity of variance. The tests used were, Student's T-Test, ANOVA, Mann Whitney U Test, Kruskal Wallis Test depending on the result of the Levene Test. For all analyses a significance level $p<0.05$ was adopted, being used for all of them, the statistical program SPSS v24 (IBM, 2017).

Results

Here are the main results of the analyses developed. Firstly, the LPA stratification and Breakfast Consumption,then LPA and Collation Consumption and finally LPA and Total Meal/Day Consumption.

With regard to**breakfast** consumption, higher averages are generally observed in Group 1 compared to Group 2. These differences are statistically significant through the Student's T-Test in the General Average (p= .037) and Mathematics Average (p= .004). See Table 2.

Table 2: *School grades average (SD) according to LPA and breakfast consumption*

School grades average	Group 1 (n=273)	Group 2 (n=193)	*P*
General	5.50 (0.61)	5.37 (0.66)	< 0.05
Language	5.29 (0.80)	5.23 (0.76)	> 0.05
Mathematics	5.17 (0.81)	4.94 (0.86)	< 0.01

Group 1: students with High LPAand breakfast consumption.
Group 2: students with Low LPA and no breakfast consumption.

When analyzing by gender, in men in both groups there are no significant differences in academic performance.Whereas, in women, as we see in Table 3, students in Group 1 achieve averages higher than those in Group 2, being statistically significant through Student's T-Test for the average in Language (.034), Mathematics (.004) and General (.009)

Table 3: *School grades average (SD) in women students, according to LPA and breakfast consumption*

School gradesaverage	Group 1 (n=114)	Group 2 (n=144)	*p*
General	5.60 (0.61)	5.39 (0.65)	< 0.01
Language	5.47 (0.77)	5.26 (0.78)	< 0.05
Mathematics	5.25 (0.84)	4.94 (0.86)	< 0.01

Group 1: students with High LPA and breakfast consumption.
Group 2: students with Low LPA and no breakfast consumption.

According to standardized test scores and through Student's T-Test, a statistically significant difference was observed in the Language Test (*p*= .023), where students in Group 2 achieve averages superior to students in Group 1. On the contrary, in the Mathematics test, students in Group 1 achieve a statistically significant average superior to Group 2 (*p*= .017).When analyzing by gender, no significant differences are observed. See Table 4.

Table 4:*Average (SD) of Standardized Test Scores according to LPA and Breakfast Consumption*

Characteristic	Group 1 (n=273)	Group 2 (n=193)	*p*
StandardizedLanguage Test	50.53 (15.69)	53.90 (15.78)	< 0.05
StandardizedMathematics Test	37.55 (12.61)	34.75 (12.07)	< 0.05

Group 1: students with High LPA and breakfast consumption.
Group 2: students with Low LPA and no breakfast consumption.

In the **collation** consumption higher means were shown in Group 1, this difference being statistically significant through the Student's T-Test *(p*= .021),only in the mathematics average. See table 5

Table 5: *School grades average (SD) according to LPA and collation consumption*

School grades average	Group 1 (n= 252)	Group 2 (n= 171)	*p*
General average	5.47 (0.59)	5.41 (0.67)	> 0.05
Language average	5.23 (0.76)	5.25 (0.79)	> 0.05
Mathematic average	5.13 (0.84)	4.94 (0.82)	< 0.05

Group 1: students with High LPA and collation consumption.
Group 2: students with Low LPA and no collation consumption.

When analyzing by gender, there are no significant differences in men. In women, however, we see that students in Group 1 reach averages higher than those in Group 2. This difference is statistically significant through Student's T-Test in Mathematics (*p*=.009), where the mean of Group 1 reaches 5.20 (±0.80) and the mean of Group 2 reaches 4.93 (±0.80).

analyzing standardized test scores, no statistically significant differences were observed.

In total meal/day consumption, in general and by gender, averages in Group 1 were higher than in Group 2, being this difference statistically significant through Student's T-Test (*p*=.015), in the Mathematics average. See table 6.

Table 6:*School grades average (SD) according toLPA and total meal/day consumption*

School grades average	Group 1 (n= 157)	Group 2 (n= 254)	p
General average	5.53 (0.61)	5.44 (0.68)	> 0.05
Language average	5.32 (0.79)	5.28 (0.78)	> 0.05
Mathematics average	5.21 (0.81)	5.00 (0.87)	< 0.05

Group 1: students with High LPA and consumption of four meals/day.
Group 2: students with Low LPA and consumption of three or less meals/day.

When analyzing by gender, there are no significant differences in men. In women, however, we see that students in Group 1 reach averages higher than those in Group 2. This difference is statistically significant through Student's T-Test in mathematics (p=.012), where the mean of Group 1 reaches 5.27 (±0.79) and group 2, 4.97 (±0.85). When analyzing standardized test scores, no statistically significant differences were observed.

Discussion

The results of our research show that those who had a high LPA and consumed breakfast, collation and ate four times a day,reached school grades averages significantly higher than those with a low LPA and did not consume meals.Research has shown a positive relationship between eating habits and academic performance among adolescents (Adolphus, Lawton, & Dye, 2013; Bravo, 2017; Correa-Burrows, Burrows, Orellana, & Ivanovic, 2015; Jáuregui-Lobera, 2011; Lundqvist, Ennab Vogel, & Levin, 2018; Rampersaud, Pereira, Girard, Adams, &Metzl, 2005; Sampasa-Kanyinga& Hamilton, 2017; So, 2013).Similarly, between level of physical activity and academic performance (Cancela, Ayán, &Sanguos, 2016; Castro, Pérez, Cachón, &Zagalaz, 2016; Correa-Burrows, Burrows, Orellana, & Ivanovic, 2014; González &Portolés, 2014; Hillman, Erickson, & Kramer, 2008; Kari, Pehkonen, Hutri-Kahonen, Raitakari, &Tammelin, 2017; Maureira et al., 2014; Morales, Pellicer-Chenoll, Garcia-Masso, Gomis, & Gonzalez, 2011).

With regard to the interrelationship between the level of physical activity and eating habits, and its influence on academic performance, it has been stated thatspecific dietary behaviors and the practice of self-reported physical activity, were associated with better academic performance (Asigbee et al., 2018; Burns et al., 2018).In the same way, Faught et al. (2017) showed that both the practice of physical activity and compliance with food recommendations, were associated with higher chances of having a high academic performance in both mathematics and language, agreeing with Edwards, Mauch, and Winkelman (2011), who highlight nutritional aspects and physical activity in academic performance,so they call on schools to promote them as part of a healthy lifestyle for learning.

Conclusions

The results of this research make it possible to establish that in the joint analysis of the LPA and eating habits on academic performance, we emphasize that those who had High LPA and also the habit of breakfast,were those who obtained higher means in school grade averages: General, Language and Mathematics and in the Standardized Mathematics Test. For its part, those who had High LPA and ate collation got higher Mathematics averages than those with Low LPA and did not eat collation.In addition, those who had High LPA and ate four meals a day, reached higher averages than those with Low LPA and who ate three or less meals a day. In a gender analysis we observed in LPA stratification and collation consumption, and 4 meals a day, that these differences werestatistically significant in women.

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Conflicts of interest -The authors declare that there is no interest or relationship with trademarks that manufacture or distribute the instruments used in this study.

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