

Original Article

Secular Changes in Height, Weight, Body Mass Index and Daily Nutrition Preferences in Children During Soccer Recruitment Camps

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Abstract:

This study was conducted to compare secular changes in height, weight, and body mass index and to survey children's daily nutrition, hydration preferences and preferred beverages while exercising. Soccer recruitment camps were organized by a professional Spanish soccer club in Costa Rica in December 2011. Participants were 884 children measured for anthropometrics and surveyed on nutritional practices and hydration preferences. Results indicated that children were significantly heavier, taller and had higher body mass indexes compared to Costa Rican national norms from year 1996-1998 ($p < 0.05$). Based on international z -score classifications, we found 10.4% underweight, 75.3% normal weight, 9.6% overweight, and 4.6 % obese children. In general, children consuming water daily were taller and heavier than children consuming powdered beverages ($p < 0.05$), carbonated beverages ($p < 0.05$), and coffee ($p < 0.05$); and children daily consuming natural juices were taller than children consuming carbonated beverages ($p < 0.05$). Children daily consuming water had higher BMI than children consuming powdered beverages ($p = 0.008$) and coffee ($p = 0.003$). However, these differences disappeared when age groups were taken into consideration for statistical analyses. In general, 92.2% of the participants had breakfast and consumed sports drinks (56.7%) while practicing sports, followed by water (36.1%), carbonated beverages (3.6%), natural juices (1.8%), powdered/sweetened beverages (1.5%), and energy drinks (0.3%). In conclusion, positive changes in secular growth were observed in Costa Rican children. Daily coffee consumption was related to lower height, weight and body mass index compared to hydrating with plain water. Sports drinks were widely consumed by children during exercise and energy drinks appear to be misleadingly promoted as sport drinks.

Key Words: soccer, children, nutritional habits, hydration.

Introduction

Association football (i.e., football or soccer) is the most popular sport in the world, and its governing body, the Federation International of Football Association (FIFA), gathers 208 countries and more than 250 million players (FIFA, 2012). Professional soccer clubs invest significant amounts of money in grassroots, and local and international soccer-scouting has become an art and a science (Bertuzzi, 1999). Scouts look for anthropometric characteristics such as height, weight, body mass index ($BMI = \text{weight in kg}/\text{height in m}^2$), maximal oxygen consumption ($VO_2\text{max}$) and other physiological and psychological variables (Hopper, Guthrie & Kelly, 1991) to determine the best player's profile for their organization (Strøyer, Hansen & Klausen, 2004). Soccer is widely popular in Latin American countries such as Costa Rica, where secular changes in children's height and weight of children has never been reported and might provide valuable information for scouts. Secular changes are modifications in physical and physiological characteristics resulting from environmental changes (Van Wieringen, 1986).

However, there is a plethora of variables known to impact soccer performance besides anthropometric characteristics, including nutrition practices and specifically hydration habits (Dougherty, Baker, Chow & Kenney, 2006). Knowledge regarding hydration habits is important not only for soccer scouts but also for children exercising in hot environments (i.e., summer camps). Dehydration has well-documented deleterious effects on physical and cognitive performance (Bar-David, Urkin & Kozminsky, 2005; Dougherty et al., 2006), and although children have the ability to rate their hydration to determine whether their hydration practices are good or not (Decher et al., 2008); hydration practices and fluid replacement strategies vary widely among children from different age groups, ethnicities and countries of birth (Bar-David, Urkin, Landau, Bar-David, & Pilpel, 2009).

According to Popkin (2010), beverage intake (i.e., type and quantity of a given beverage) has changed in the general population in the last 50 years. For instance, children drink less milk and juices than they did 50 years ago. They also drink more sugar-sweetened beverages than they did in 1960. Exposure to food advertising on television has been associated with higher consumption of soft drinks (i.e., carbonated drinks) and fast food in children (Andreyeva, Kelly & Harris, 2011). This trend is relevant from a public health perspective since high-quality basic nutrients provided by beverages such as milk are lacking in most sugar-sweetened beverages.

Furthermore, children and adolescents currently consume energy drinks, beverages marketed in sports settings, which include within its ingredients large quantities of caffeine, sugar, carbohydrates (CHO) and central nervous system stimulants and supplements such as guarana, taurine, ginseng, and vitamin B complex (Kaminer, 2010).

Inadequate water intake is also a concern not only for children, but also for the general population. A survey on water intake among 4,292 students in grades six through eight in USA (Park, Sherry, O'Toole, & Huang, 2011), revealed that about 64% of students had low water intake. Park et al. (2011), identified through a regression analysis that Hispanics were among the youth less likely to drink water. Recent evidence (Edmonds & Burford, 2009), suggests that water intake in children aged 7-9 is related to improved cognitive tasks (i.e., visual attention) and positively affects children's thirst perception.

We aimed at surveying beverage consumption in a field study in Costa Rican children and adolescents due to a lack of previous local studies about this subject. These types of studies are relatively new (Nelson, Neumark-Sztainer, Hannan, & Story, 2009; Fiorito, Marini, Mitchell, Smiciklas-Wright, & Birch, 2010) and commonly performed over a 5 year period (i.e., longitudinal). For instance, Nelson et al. (2009), examined longitudinal and secular changes in beverage intake in a large ($n = 2516$) sample of adolescents in USA. The researchers were interested in looking at daily nutrition preferences that remain or change over time (i.e., 5 yr.) in children during their transition to adolescence. The study by Nelson et al. (2009), indicates that consumption of soda and sugar sweetened beverages (including soda, sweetened iced teas, and fruit drinks) increased significantly among younger males in a five-year period. Researchers also found that consumption of certain beverages decreased with age. For instance, fruit juice consumption decreased among all males and older females, milk among older adolescents, other milk beverages among all females and older males, diet soda among younger adolescents, and coffee/tea among all males and younger females. These findings also include secular decreases in fruit juice and coffee/tea consumption for males and females.

Fiorito et al. (2010), studied 170 females over a 5 yr. period to describe changes in beverage intake during childhood. Fiorito et al. (2010), found that relative to girls who were not consuming soda beverages at age 5, soda consumers at age 5 had higher subsequent soda intake, lower milk intake, higher intake of added sugars, which impacted protein, fiber and micronutrients (e.g., calcium, magnesium, phosphorous, potassium) and vitamin D. In general, soda consumption was found to be predictive of unhealthy nutrition preferences of children. Overall, the findings from Nelson et al. (2009) and Fiorito et al. (2010), indicated secular, longitudinal shifts, and gender specific beverage consumption changes during childhood to adolescence.

Based on the previous context, the purpose of this study on children participating in soccer recruitment camps was to compare secular changes in height, weight, BMI, and to survey children's daily nutrition, hydration preferences and preferred beverages while exercising.

Material & methods

Participants

Eight hundred and eighty four ($n = 884$) male children and youth aged 7-18 volunteered to participate in a soccer scouting camp in December 2011 in 10 Costa Rican locations. Flyers and newspaper advertisements were posted to announce that scouts from a professional soccer club in Spain were interested in evaluating soccer players.

Measurement instruments

Height (cm) was measured by children's standing barefoot on a portable stadiometer (SECA B-T214, Leicester, UK). Weight (kg) was measured standing on a SECA System B-841 digital scale (Hamburg, Germany) accurate to ± 100 g. Then BMI (kg/m^2) was computed from these values. A survey on breakfast consumption, hydration habits, and daily and exercise beverage preferences was read to each participant and responses were properly recorded by two trained researchers.

Procedures

Children and youth were given appointments at a soccer field in a specific community. Upon arrival and initial greeting to them and their parents, children were divided by age groups and height and weight were measured. Following this, children responded to the survey and then were directed to the soccer field for warm-up and specific soccer-skill and game situation drills. Then, scouts observed each participant and rated his performance as: a) "outstanding", b) "could be outstanding", and c) "does not excel". Participants were on the soccer field for about 90 minutes and upon completion of the camp they were gathered again and recognized for their effort. Scouts kept a detailed record of selected children who were going to be called by phone for another trial. The final selection process took place and three children were selected to travel to Spain.

Statistical analysis

Data were analyzed with the Statistical Package for the Social Sciences (SPSS®), version 15.0 for Windows. Data are presented as means (M) and standard deviation ($\pm SD$), unless otherwise noted, and statistical significance was set *a priori* at $p < 0.05$.

One-sample t tests were used to determine significant mean differences in height, weight and BMI by age group, from 2012 recruits and normative data for Costa Rican students measured from 1996 to 1998 (Fernández et al., 2001). One-way analyses of variance (ANOVA) were computed to determine significant mean differences in height, weight and BMI in children's reported daily consumption of beverages. Also, one-way ANOVA was computed to determine significant mean BMI differences among soccer positions. Appropriate *post hoc* analyses

based on homogeneity of variance (e.g., Tukey, Dunnet) were performed when significant mean differences were found.

Non-parametric Chi-squared (χ^2) analyses were used to determine significant associations between breakfast ingestion and rated performance and between rated performance and beverage intake during exercise.

Results

Participants were 884 children aged 7-8 (2.7%), 9-10 (13.9%), 11-12 (30.0%), 13-14 (30.7%), 15-16 (21.0%), and 17-18 (1.7%) years old. Descriptive statistics for anthropometric variables height, weight and BMI for each age group are shown in table 1.

Table 1. Descriptive statistics (M \pm SD) for anthropometric variables of children participating in a recruitment soccer camp (n = 884).

Variable	Age group					
	7-8 (n = 24)	9-10 (n = 123)	11-12 (n = 265)	13-14 (n = 271)	15-16 (n = 186)	17-18 (n = 15)
Height (cm)	127.7 \pm 5.0	135.7 \pm 6.2	146.3 \pm 7.7	158.9 \pm 9.0	167.7 \pm 6.4	168.8 \pm 14.0
Weight (kg)	27.5 \pm 5.4	33.4 \pm 7.4	40.9 \pm 10.1	50.3 \pm 10.0	60.1 \pm 10.1	64.4 \pm 13.0
BMI (kg/m ²)	16.7 \pm 2.4	18.0 \pm 3.0	18.9 \pm 3.3	19.8 \pm 2.8	21.3 \pm 3.0	22.5 \pm 3.8

Note:

BMI = Body mass index

Anthropometric characteristics

Based on international z-score classifications (Cole, Bellizzi, Flegal, & Dietz, 2000; Cole, Flegal, Nicholls, & Jackson, 2007), we found 10.4% underweight ($z \leq -1$), 75.3% normal weight ($z \geq -1$ to $\leq +1$), 9.6% overweight ($z > +1$), and 4.6 % obese ($z > +2$) children.

Player positions represented in the study were goalkeepers (7.4%), defenders (22.7%), midfielders (38.2%), and strikers/forwards (31.1%). Only a few players (0.6%) indicated playing in any position required by the coach. Based on their observations on the field, Spanish scouts classified participants as “outstanding” (2.9%), “could be outstanding” (23.8%), and “does not excel” (73.0%).

One-way ANOVA revealed significant ($p = 0.001$) mean BMI differences by field position. Tukey’s HSD *post hoc* analysis indicated that strikers had the lowest BMI ($M = 16.7 \pm 3.0$ kg/m²) compared to midfielders ($M = 19.7 \pm 3.2$ kg/m²; $p = 0.001$), defenders ($M = 20.3 \pm 3.5$ kg/m²; $p = 0.001$), and goalkeepers ($M = 20.7 \pm 3.3$ kg/m²; $p = 0.001$).

One-sample *t* tests revealed significant mean differences in height (cm) between 2012 recruits to the general Costa Rican student population aged 9 ($M_{2012} = 133.6 \pm 5.5$ cm vs. $M_{1996-1998} = 131.1 \pm 5.6$ cm; $p = 0.001$), 11 ($M_{2012} = 143.6 \pm 6.5$ cm vs. $M_{1996-1998} = 140.8 \pm 6.8$ cm; $p = 0.001$), 12 ($M_{2012} = 149.3 \pm 7.6$ cm vs. $M_{1996-1998} = 145.7 \pm 7.3$ cm; $p = 0.001$), 13 ($M_{2012} = 156.6 \pm 9.3$ cm vs. $M_{1996-1998} = 154.2 \pm 8.3$ cm; $p = 0.001$), and 15 ($M_{2012} = 167.2 \pm 6.6$ cm vs. $M_{1996-1998} = 165.7 \pm 7.2$ cm; $p = 0.031$) years old.

One-sample *t* tests revealed significant mean differences in weight (kg) between 2012 recruits to the general Costa Rican student population aged 9 ($M_{2012} = 32.3 \pm 7.1$ kg vs. $M_{1996-1998} = 29.3 \pm 5.9$ kg; $p = 0.003$), 11 ($M_{2012} = 39.1 \pm 9.2$ kg vs. $M_{1996-1998} = 36.2 \pm 8.0$ kg; $p = 0.001$), 12 ($M_{2012} = 43.1 \pm 10.7$ kg vs. $M_{1996-1998} = 39.7 \pm 8.3$ kg; $p = 0.001$), and 15 ($M_{2012} = 59.7 \pm 11.6$ kg vs. $M_{1996-1998} = 56.4 \pm 10.1$ kg; $p = 0.005$) years old.

One-sample *t* tests revealed significant mean differences in BMI between 2012 recruits to the general Costa Rican student population aged 9 ($M_{2012} = 17.9 \pm 3.1$ kg/m² vs. $M_{1996-1998} = 16.9 \pm 2.5$ kg/m²; $p = 0.023$), 11 ($M_{2012} = 18.8 \pm 3.4$ kg/m² vs. $M_{1996-1998} = 18.1 \pm 3.2$ kg/m²; $p = 0.031$), and 15 ($M_{2012} = 21.3 \pm 3.6$ kg/m² vs. $M_{1996-1998} = 20.4 \pm 2.9$ kg/m²; $p = 0.020$) years old.

One-way ANOVA revealed significant mean differences in height between children consuming different daily beverages ($p = 0.001$). Tukey’s HSD *post hoc* analysis indicated that children consuming water daily were taller than children consuming powdered beverages ($p = 0.001$), carbonated beverages ($p = 0.001$), and coffee ($p = 0.031$). Also, children daily consuming natural juices were taller than children consuming carbonated beverages ($p = 0.049$) (Figure 1). However, mean height differences by daily beverage consumed disappeared when a one-way ANOVA was carried out by age group (Table 2).

Table 2. Mean (\pm SD) body height (cm) of children participating in a recruitment soccer camp by daily beverage consumed (n = 884).

Beverage	Age group					
	7-8 (n = 24)	9-10 (n = 123)	11-12 (n = 265)	13-14 (n = 271)	15-16 (n = 186)	17-18 (n = 15)
Water	125.9 ^a	135.2±6.3	147.4±7.4	159.8±9.5	168.1±5.7	173.8±3.5
Natural juice	129.6±4.7	136.3±7.1	146.9±7.8	160.3±8.3	168.0±5.5	172.1±3.8
Milk	129.4±3.0	130.3±5.9	143.6±6.4	154.9±4.5	171.4±8.2	175.3±4.3
Sports drink	126.9 ^a	132.3±6.2	144.9±7.4	159.7±8.7	169.7±6.9	^b
PB	127.1±5.8	136.6±8.1	145.2±6.8	158.9±9.4	165.5±6.3	175.9±5.5
CB	126.5±6.1	136.5±5.5	146.8±8.8	157.1±8.0	169.7±10.3	149.6±19.8
Coffee	^b	131.7±6.2	143.9±5.7	148.9±17.3	169.6±6.4	^b
SCB	^b	^b	141.5 ^a	^b	169.3±4.2	^b
Tea	^b	^b	^b	145.4 ^a	170.6 ^a	^b
Energy drink	^b	^b	^b	^b	162.9 ^a	^b

Note:

PB: Powdered beverage; CB: Carbonated beverage; SCB: Sugar cane beverage

^a one participant in this beverage type/age group, ^b empty cell

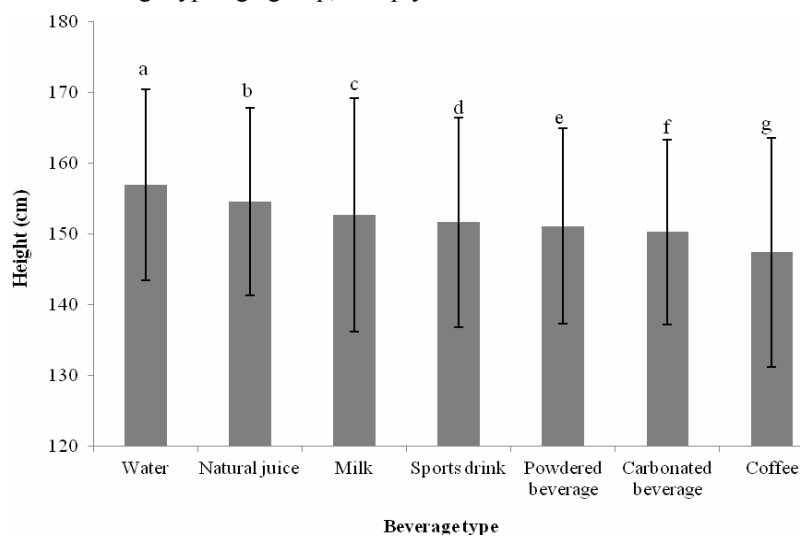


Figure 1. Differences in mean (\pm SD) height (cm) by beverage category in children participating in soccer recruitment camps ($p < 0.05$, $a > e = f = g$; $p < 0.05$, $b > f$). Significant mean differences disappear when statistical analyses were run by age group.

One-way ANOVA revealed significant mean differences in weight between children daily consuming different beverages ($p = 0.001$). Tukey's HSD *post hoc* analysis indicated that children daily consuming water had higher weight than children consuming carbonated beverages ($p = 0.001$), powdered beverages ($p = 0.001$), and coffee ($p = 0.002$) (Figure 2). However, mean weight differences by daily beverage consumed disappeared when a one-way ANOVA was carried out by age group (Table 3).

Table 3. Mean (\pm SD) body weight (kg) of children participating in a recruitment soccer camp by daily beverage consumed (n = 884).

Beverage	Age group					
	7-8 (n = 24)	9-10 (n = 123)	11-12 (n = 265)	13-14 (n = 271)	15-16 (n = 186)	17-18 (n = 15)
Water	23.4 ^a	32.8±7.4	43.5±12.9	52.3±12.2	62.2±10.3	78.1±18.1
Natural juice	29.3±3.5	35.0±9.3	41.8±11.1	50.5±9.6	60.5±8.6	62.6±4.7
Milk	33.0±2.9	25.6±2.7	37.1±3.9	46.7±2.8	62.9±10.9	63.2±4.7
Sports drink	23.8 ^a	31.3±4.3	38.4±7.7	52.7±13.1	59.8±4.8	^b
PB	26.7±6.6	34.0±6.9	39.5±7.5	50.6±9.6	56.5±8.3	64.3±12.1
CB	26.2±2.7	33.6±6.8	42.1±11.4	48.9±8.1	62.8±18.2	57.6±20.3
Coffee	^b	28.1±3.5	36.5±6.9	41.0±14.4	59.3±12.0	^b
SCB	^b	^b	37.0 ^a	^b	56.7±0.9	^b
Tea	^b	^b	^b	34.4 ^a	63.3 ^a	^b
Energy drink	^b	^b	^b	^b	47.0 ^a	^b

Note:

PB: Powdered beverage; CB: Carbonated beverage; SCB: Sugar cane beverage

^a one participant in this beverage type/age group

^b empty cell

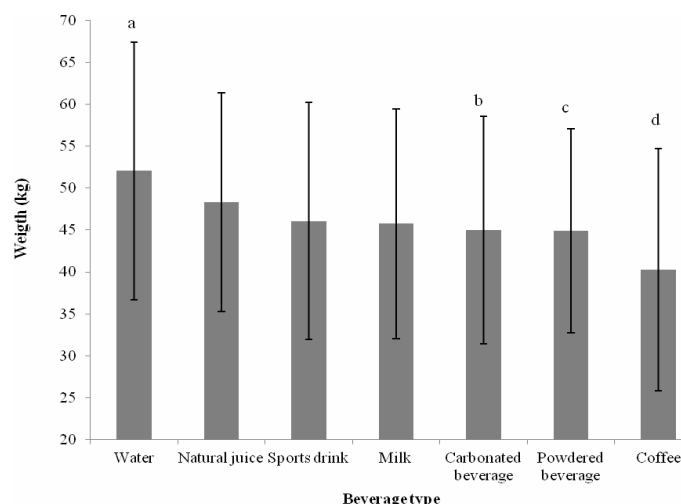


Figure 2. Differences in mean (\pm SD) weight (kg) by beverage category in children participating in soccer recruitment camps ($p < 0.05$, $a > b = c = d$). Significant mean differences disappear when statistical analyses were run by age group.

One-way ANOVA revealed significant mean differences in BMI between children daily consuming different beverages ($p = 0.001$). Dunnet's *post hoc* analysis indicated that children daily consuming water had higher BMI than children consuming powdered beverages ($p = 0.008$), and coffee ($p = 0.003$) (Figure 3). Again, mean BMI differences by daily beverage consumed disappeared when a one-way ANOVA was carried out by age group (Table 4).

Table 4. Mean (\pm SD) body mass index (kg/m^2) of children participating in a recruitment soccer camp by daily beverage consumed ($n = 884$).

Beverage	Age group					
	7-8 (n = 24)	9-10 (n = 123)	11-12 (n = 265)	13-14 (n = 271)	15-16 (n = 186)	17-18 (n = 15)
Water	14.8 ^a	17.8 \pm 3.2	19.7 \pm 4.0	20.2 \pm 3.2	21.9 \pm 3.2	26.0 \pm 7.0
Natural juice	17.4 \pm 1.6	18.7 \pm 3.7	18.9 \pm 3.9	19.5 \pm 2.6	21.4 \pm 3.2	21.1 \pm 0.7
Milk	19.8 \pm 2.6	15.0 \pm 0.2	17.9 \pm 1.7	19.5 \pm 1.2	21.3 \pm 2.4	20.5 \pm 0.5
Sports drink	14.8 ^a	17.8 \pm 0.8	18.6 \pm 2.5	20.5 \pm 4.1	20.8 \pm 1.0	^b
PB	16.3 \pm 2.8	18.2 \pm 2.7	18.6 \pm 2.6	19.9 \pm 3.1	20.6 \pm 2.5	20.7 \pm 2.6
CB	16.3 \pm 0.2	17.9 \pm 2.8	19.3 \pm 3.3	19.7 \pm 2.3	21.5 \pm 4.1	25.1 \pm 4.6
Coffee	^b	16.1 \pm 0.6	17.5 \pm 2.6	17.8 \pm 2.9	20.4 \pm 2.7	^b
SCB	^b	^b	18.5 ^a	^b	19.8 \pm 0.6	^b
Tea	^b	^b	^b	16.3 ^a	21.7 ^a	^b
Energy drink	^b	^b	^b	^b	17.7 ^a	^b

Note: PB: Powdered beverage; CB: Carbonated beverage; SCB: Sugar cane beverage

^a one participant in this beverage type/age group, ^b empty cell

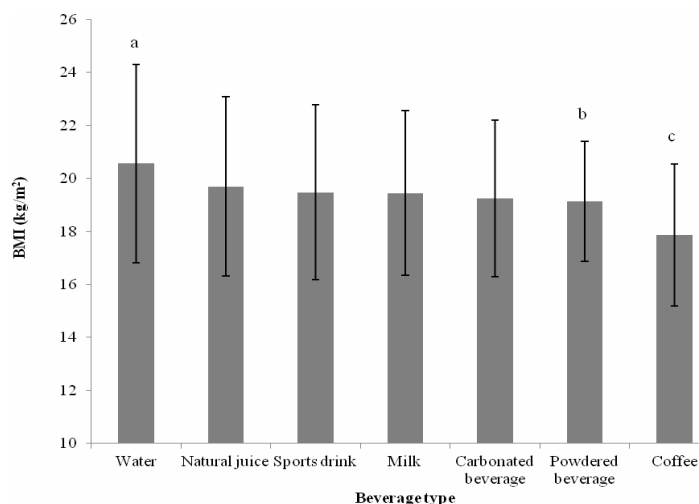


Figure 3. Differences in mean (\pm SD) BMI (kg/m^2) by beverage category in children participating in soccer recruitment camps ($p < 0.05$, $a > b = c$). Significant mean differences disappear when statistical analyses were run by age group.

Nutritional information

Nutritional habits information showed that 92.2% of the participants had breakfast that day. The preferred drink ingested while practicing sports were sport drinks (56.7%), water (36.1%), carbonated beverages (3.6%), natural juices (1.8%), powdered/sweetened beverage mix (1.5%), and energy drinks (0.3%). Consumption of sport-drinks included two well-known international commercial brands. We found that 53.4% participants ingested beverage 1 (usual composition: CHO = 8%, Na⁺ = 5 mmol/l, K⁺ = 3 mmol/l, Osmolality = 381 mosm/kg H₂O) and 42.9% beverage 2 (usual composition: CHO = 6%, Na⁺ = 20 mmol/l, K⁺ = 3 mmol/l, Osmolality = 325-380 mosm/kg H₂O) (Maughan & Murray, 2001). Some children considered carbonated beverages and energy drinks as sport drinks (Coca-Cola[®], 3.1%, Big-Cola[®], 0.4%, and Jet[®], 0.2%). Daily hydration habits in the children's diet included powdered/sweetened beverage mix (30.7%), natural juices (26.8%), water (17%), carbonated beverages (16%), sport drinks (3.4%), milk (2.7%), coffee (2.6%), sugar cane blend (0.3%), tea (0.2%), and energy drinks (0.1%).

One-way ANOVA revealed significant mean height differences in the 13-14 age group ($p = 0.037$). Tukey's HSD *post hoc* analysis showed that participants consuming carbonated beverages had significantly lower heights than participants consuming sport drinks ($p = 0.022$) and water ($p = 0.017$). In the 17-18 age group participants consuming sport drinks were significantly taller than participants consuming water ($p = 0.001$) (Table 5).

Table 5. Mean (\pm SD) body height (cm) of children participating in a recruitment soccer camp by preferred beverage consumed during sports participation (n = 884).

Beverage	Age group					
	7-8 (n = 24)	9-10 (n = 123)	11-12 (n = 265)	13-14 (n = 271)	15-16 (n = 186)	17-18 (n = 15)
Water	126.8 \pm 5.4	135.5 \pm 6.9	146.9 \pm 7.8	159.5 \pm 9.1 ^c	167.6 \pm 6.0	171.3 \pm 7.7
Natural juice	134.5 ^a	134.5 \pm 1.5	148.8 \pm 8.2	161.0 \pm 2.6	164.5 \pm 4.2	^b
Sports drink	127.4 \pm 4.9	137.3 \pm 7.1	145.7 \pm 7.3	159.0 \pm 8.8 ^c	167.8 \pm 6.5	174.1 \pm 4.2 ^d
PB	130.1 \pm 5.9	130.8 \pm 4.5	148.5 \pm 15.8	156.1 \pm 6.1	149.4 ^a	^b
CB	127.3 ^a	132.2 \pm 5.6	146.6 \pm 6.6	150.1 \pm 12.2 ^c	168.7 \pm 3.2	127.2 ^a
Energy drink	^b	123.3 ^a	^b	^b	170.9 \pm 0.7	^b

Note:

PB: Powdered beverage; CB: Carbonated beverage; SCB: Sugar cane beverage

^a one participant in this beverage type/age group

^b empty cell

^c ANOVA, $p = 0.037$; CB < Sports drink, $p = 0.022$; CB < Water, $p = 0.017$.

^d ANOVA, Sports drink > Water, $p = 0.001$.

Also, One-way ANOVA revealed significant mean body weight differences in the 13-14 age group ($p = 0.015$). Tukey's HSD *post hoc* analysis showed that participants consuming carbonated beverages had significantly lower body weight than participants consuming water ($p = 0.012$). Again, in the 17-18 age group participants consuming sport drinks had significantly lower body weight than participants consuming water during sports practice ($p = 0.014$) (Table 6).

Table 6. Mean (\pm SD) body weight (kg) of children participating in a recruitment soccer camp by preferred beverage consumed during sports participation (n = 884).

Beverage	Age group					
	7-8 (n = 24)	9-10 (n = 123)	11-12 (n = 265)	13-14 (n = 271)	15-16 (n = 186)	17-18 (n = 15)
Water	27.4 \pm 4.4	33.7 \pm 7.9	42.6 \pm 12.1	52.2 \pm 10.8	60.8 \pm 10.7	69.9 \pm 10.2
Natural juice	31.2 ^a	30.8 \pm 6.0	38.6 \pm 5.0	48.6 \pm 1.0	55.5 \pm 4.9	^b
Sports drink	26.0 \pm 5.6	34.8 \pm 7.3	39.9 \pm 9.1	49.9 \pm 9.2	59.6 \pm 9.9	60.5 \pm 6.6 ^d
PB	30.1 \pm 9.5	31.1 \pm 4.3	43.2 \pm 7.5	44.6 \pm 7.3	47.5 ^a	^b
CB	35.1 ^a	27.9 \pm 4.2	44.2 \pm 9.7	41.6 \pm 10.9 ^c	55.5 \pm 3.6	35.0 ^a
Energy drink	^b	31.3 ^a	^b	^b	68.0 \pm 1.5	^b

Note:

PB: Powdered beverage; CB: Carbonated beverage; SCB: Sugar cane beverage

^a one participant in this beverage type/age group

^b empty cell

^c ANOVA, $p = 0.015$. CB < Water, $p = 0.012$.

^d ANOVA, Sports drink < Water, $p = 0.014$.

No significant mean differences were detected in BMI among age groups as they relate to beverage consumption (Table 7).

Table 7. Mean (\pm SD) body mass index (kg/m^2) of children participating in a recruitment soccer camp by preferred beverage consumed during sports participation ($n = 884$).

Beverage	Age group					
	7-8 (n = 24)	9-10 (n = 123)	11-12 (n = 265)	13-14 (n = 271)	15-16 (n = 186)	17-18 (n = 15)
Water	16.9 \pm 1.8	18.1 \pm 2.9	19.4 \pm 3.9	20.3 \pm 3.0	21.6 \pm 3.2	23.9 \pm 4.2
Natural juice	17.2 ^a	16.9 \pm 2.9	17.4 \pm 1.6	18.8 \pm 0.3	20.5 \pm 0.8	^b
Sports drink	15.9 \pm 2.4	18.3 \pm 3.1	18.7 \pm 3.0	19.6 \pm 2.8	21.1 \pm 2.9	19.9 \pm 1.3
PB	17.6 \pm 3.9	18.1 \pm 1.3	19.6 \pm 0.8	18.2 \pm 1.7	21.3 ^a	^b
CB	21.7 ^a	15.9 \pm 1.4	20.5 \pm 3.9	18.1 \pm 2.4	19.5 \pm 0.5	21.6 ^a
Energy drink	^b	20.6 ^a	^b	^b	23.3 \pm 0.3	^b

Note:

PB: Powdered beverage; CB: Carbonated beverage; SCB: Sugar cane beverage

^a one participant in this beverage type/age group, ^b empty cell

Chi-squared analyses indicated an association between performance categories and breakfast intake. A low proportion of children who did not have breakfast were allocated in the category of “could be outstanding” and a high proportion of children who had breakfast were allocated in the category of “does not excel” ($\chi^2 = 6.96$; $p = 0.031$). Chi-squared analyses also indicated an association between performance categories and beverage consumed while exercising. A high proportion of children categorized as “outstanding” drank water, and a high proportion of children categorized as “could be outstanding” consumed sports drinks ($\chi^2 = 7.08$; $p = 0.029$).

Dicussion

The goal of the study was to compare changes in height, weight and BMI of children attending soccer camps to national norms obtained in 1996-1998. A second purpose of the study was to examine nutritional habits, including beverage consumption in this group of children. In Costa Rica, only a study on height, weight and BMI using a representative national sample of children has been published (Fernández et al., 2001). Children were found to be taller (~2.6 cm) at ages 9, 11, 12, 13, and 15; heavier (~3 kg) at ages 9, 11, 12, and 15; and showed higher BMI (~0.9 kg/m^2) at ages 9, 11 and 15, compared to their peers of the same age measured from 1996 to 1998 (Fernández et al., 2001; Fernández-Ramírez & Moncada-Jiménez, 2003). This increasing trend in size has been previously described in other populations (Harten, 1999; Olds & Harten, 2001), and do not necessarily match positive changes in physical fitness variables (e.g., higher VO_2max , strength, power) (Tomkinson, L’eger, Olds, & Cazorla, 2003; Tomkinson, Hamlin, & Olds, 2006). Lago-Peñas, Casais, Dellal, Rey and Dominguez (2011), measured 321 male soccer players aged 12-19 years and found that midfielders were smaller than goalkeepers, defenders and forwards. Defenders and goalkeepers were the tallest and heaviest players. In the present study the forwards were the lighter players relative to their height (i.e., low BMI), compared to midfielders, defenders and goalkeepers. Lago-Penas et al. (2011), found an association between composition (i.e., leanness and muscularity) and success at the end of the season. More research is needed to confirm this association taking into consideration several variables that might influence body composition (e.g., genetics, nutrition, practice of other sports, etc.). In this study, children regularly drinking coffee showed smaller height and lower weight and BMI than children drinking water daily. The potential causal physiological mechanisms responsible for this association are beyond the scope of this study; however, caffeine-containing beverages have been related a skeletal fragility explained by low intestinal calcium absorption (Heaney, 2002). Indeed, calcium-rich foods (e.g., milk, fish, green vegetables, nuts) have been consistently related to a positive bone health (Winzenberg, Shaw, Fryer, & Jones, 2006; Clark, Tobias, & Ness, 2006), thus preventing fractures in children and adolescents (Black, Williams, Jones, & Goulding, 2002). The latter is especially important since Rumpf and Cronin (2012), reported that ~6% of all soccer-related injuries in children aged 8-18 are fractures. At this time it is unknown the calcium and/or dairy intake of the Costa Rican population; however, evidence suggests a low micronutrient intake (as a proportion of total energy) in the diet of Costa Rican adolescents (Kabagambe, Baylin, Irwig, Furtado, Siles, Kim, & Campos, 2005).

Daily hydration habits of the children surveyed in this study included a higher proportion of carbonated beverages (i.e., caffeine-containing drinks) than milk, which might have a negative impact in children’s bone health (Whiting, Healey, Psiuk, Mirwald, Kowalski, & Bailey, 2001; Goulding, Rockell, Black, Grant, Jones, & Williams, 2004). However, during exercise children consumed more sport drinks and water (92.8%) than any other fluid (7.2%). This beverage consumption might represent an appropriate behavior since adult soccer players are found to be dehydrated even before starting a soccer game (Maughan & Shirreffs, 2007; Aragon-Vargas, Moncada-Jiménez, Hernández-Elizondo, Barrenechea, & Monge-Alvarado, 2009); therefore, it is desirable to encourage children drinking water or a sport drink whenever possible, especially when exercising in the heat (Aragón-Vargas et al., 1999).

Milk, chocolate milk and flavored milk is currently being studied in adults to determine its effects before, during and after exercise (Karp, Johnston, Tecklenburg, Mickleborough, Fly, & Stager, 2006; Shirreffs, Watson, & Maughan, 2007; Watson, Love, Maughan, & Shirreffs, 2008; Thomas, Morris, & Stevenson, 2009; Pritchett, Bishop, Pritchett, Green, & Katica, 2009), and has been promoted as a new sport drink (Roy, 2008). At

 this point the findings are equivocal for both endurance performance (Thomas et al., 2009; Watson et al., 2008) and recovery indices following exercise (Karp et al., 2006; Shirreffs et al., 2007; Watson et al., 2008; Pritchett et al., 2009); therefore, more research is warranted, including populations of children and adolescents.

Energy drink consumption was reported by children attending soccer camps. These beverages differ from sport drinks in their composition and purpose; sports drinks are consumed primarily to replenish carbohydrate and electrolytes loss during exercise, while energy drinks are used to stimulate the central nervous system in activities different than sports (Seidl, Peyri, Nicham & Hauser, 2000; Barthel, Mechau, Schnittker, Liesen, & Weiß, 2001). Sports drinks have been extensively studied (Maughan & Murray, 2001), whereas energy drinks have not; yet, adult male and female athletes consume energy drinks in spite of equivocal results regarding their purported benefits on physical and psychological variables (Alford, Cox, & Wescott, 2001; Bonci, 2002; Carvajal-Sancho & Moncada-Jiménez, 2005; Umaña-Alvarado & Moncada-Jiménez, 2005a,b; Umaña-Alvarado, Solera-Herrera, & Moncada-Jiménez, 2006; Forbes, Candow, Little, Magnus, & Chilibeck, 2007; Astorino, Matera, Basinger, Evans, Schurman, & Marquez, 2012; Candow, Kleisinger, Grenier, & Dorsch, 2009). Energy drinks are considered dangerous for children (American Academy of Pediatrics Committee on Nutrition and The Council on Sports Medicine and Fitness, 2011; Seifert, Schaechter, Hershorin, & Lipshultz, 2011); therefore, adults must warrant children's safety when purchasing this type of beverages due to reported harmful effects found in adults and children associated to their consumption (Clauson, Shields, McQueen, & Persad, 2008; Rottlaender, Motloch, Reda, Larbig, & Hoppe, 2011; Rath, 2012), and follow the guidelines issued by recognized sports and medical associations (Rodríguez, DiMarco, Langley, American Dietetic Association, Dietitians of Canada, & American College of Sports Medicine, 2009; American Academy of Pediatrics Committee on Nutrition and The Council on Sports Medicine and Fitness, 2011).

In opposition to the reports regarding the effects of breakfast on academic performance (Kral, Heo, Whiteford, & Faith, 2012), research on breakfast habits in children before exercising is scarce (Vanelli, Iovane, Bernardini, Chiari, Errico, Gelmetti, Corchia, Ruggerini, Volta, & Rossetti, 2005). Vanelli et al. (2005), described breakfast habits of 747 boys and 455 girls ages 6 to 14 participating in a summer camp and found that 78% of children usually had breakfast, but 22% skip it. In our sample of 884 children we found that 92.2% had breakfast before attending practice, and this consumption was unrelated to a better performance as determined by scout's ratings.

Conclusions

In conclusion, Costa Rican children and youth attending soccer camps in the year 2011 showed positive secular changes in anthropometric variables (i.e., higher height, weight and BMI) compared to children measured in 1996-1998. Children and youth regularly have breakfast and ingest sports drinks while exercising, and children drinking coffee regularly had lower height, weight and BMI than children drinking water. A search for a causal mechanism between coffee consumption and changes in anthropometrics is warranted.

Conflicts of interest: none

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