Original Article

Effects of daily milk supplementation on improving the physical and mental function as well as school performance among children: results from a school feeding program

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Abstract

BACKGROUND: School feeding programs are important interventions for improving the nutritional status of students. Therefore, this study was conducted to evaluate the effects of milk supplementation on physical, mental and school performance of students.

METHODS: This case-control population-based intervention was conducted on 469 students from 4 schools in a medium socio-economic status region in Tehran. The schools were chosen by Iranian ministry of education and training and they were allocated in case and control groups randomly. All the students in the first to third classes in the intervention schools were daily consumed sterilized and homogenized milk for three months (250 ml each). Anthropometric measurements were done according to the standard methods. For evaluating the mental function, the Raven's Coloured Progressive Matrices (CPM) and Wechsler Intelligence Scale for children (verbal, non-verbal, total Intelligent Quotient) were conducted on students. School performance was assessed by grade-point averages of each student.

RESULTS: The weight of children was significantly different between control and intervention group at the end of the study among girls (23.0 ± 3.8 vs. 23.8 ± 4.3 kg; $p < 0.05$). Psychological tests' scores were significantly different between the control and the intervention groups ($p < 0.05$) at the end of the trial among boys. The grade-point average was significantly different at the end of the trial between the intervention and the control group among girls ($p < 0.05$).

CONCLUSIONS: School feeding programs focus on milk supplementation had beneficial effects on the physical function and school performances specifically among girls in Iran.

KEYWORDS: Milk, Mental Processes, Education Status, Health, Motor Activity.

Dietary intake has an important role in improving physical and mental function as well as the learning abilities of children.[1] Therefore considering the nutritional intakes of school-aged children could be important in this regard.[2] Malnutrition might cause several problems in the trend of growth and accelerate cognitive impairment.[3] Previous studies in Iran showed that the dietary quality of Iranians needs to be improved.[4] Existence of malnutrition besides the growing prevalence of chronic diseases due to over-nutrition among Iranian children reveals the importance of dietary intake considerations.[5,6] The double burdens of nutritional disorders among young children imply conducting nutritional pro-

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grams for accelerating the growth rate of children and improving the school tasks.[7] School feeding programs are important and comprehensive policies in this regard.[7] Food-based interventions have several benefits including providing additional energy, protein, and nutrients in a familiar form that can be considered in the usual diet.[8] Previous studies regarding school based programs in Vietnam showed beneficial results for improving the nutrient intakes.[8,9] Furthermore, there are some evidence regarding the association between chronic malnutrition and endocrine changes that might alter the metabolic profile of preschool children.[10] This might emphasis on the population trials to improve the nutritional status of children.[4]

Based on the published documents, dietary behaviors of students need to be corrected in order to reach better performance and health. Sugar sweetened beverages are mostly consumed by children and adolescents worldwide.[11] However, dairy consumption does not meet the recommended amounts by dietary guidelines.[12] Nutritionists believe that milk is more nutritious than sugar sweetened beverages. School milk programs represent an important vehicle for the promotion of milk intake among children. Such programs are now interfacing a resurgence of interest and are most applicable methods for presenting milk to children.[13]

Previous studies indicated the importance of daily milk supplementation in improving the nutrients and dietary intake of children.[7-9] School feeding programs in Iran also might improve the nutritional status among children. According to our knowledge, there are not reports regarding the evaluation of daily milk supplementation among Iranian children. We hypothesized that daily milk supplementation could improve the health status of Iranian children. Furthermore, school feeding programs could increase and privilege the healthy food choices among children. Assessing the results of such programs could change and provide some new policies in health care systems which could improve the health status of

vulnerable groups. Therefore, we decided to determine the effects of daily milk supplementation on the physical and mental function and school performance among Iranian children.

Methods
Subjects: 469 students were selected for this case-control population-based intervention from 4 primary schools in a medium socio-economic status region in Tehran, Iran (two girls' schools and two boys' schools). In either case one school was an intervention and one was a control school. The schools were chosen by Iranian Ministry of Education and Training and they were allocated in case and control groups randomly. All the students in the first to third classes in the intervention schools were consumed daily milk. None of the students in the control schools were given daily milk supplementation. All the 4 primary schools were in a medium socio-economic status region in Tehran. Therefore, there were no significant differences between the participants regarding the socio-demographic status. There was one girl school and one boy school in the intervention and one girl school and one boy school in the control. They were matching regarding the sex variable. Therefore, there were no significant differences regarding their age group. In 2 separated sessions the objectives of the project were explained to the students' parents and the principals of the schools to obtain their collaboration before beginning the intervention. Iranian Ministry of Education and Training has ordered this project to Shaheed Beheshti University of Medical Sciences. This was a joint research project by National Nutrition and Food Technology Institute, Shaheed Beheshti University of Medical Sciences, Tehran, Iran and Iranian Tetra-pack company in Tehran with the collaboration of Al-Zahra University in Tehran, Iran (Research Project Number: 001). Written informed consent was taken from all students' parents.

Anthropometric measurements and questionnaires: General and socio-demographic characteristics of the students were collected

with a pre-tested checklist. Socio-economic status was assessed by asking the number of sisters or brothers, having a separated room for the children, and the occupation of the parents. 24 hour dietary recalls were used for assessing the food intake one time during the study.[14] Dietary recalls were provided by the parents of the children. Anthropometric measurements were done according to the standard methods at the rest time, by the trained nutritionist of the study at the beginning of the intervention and after 3 months of daily milk supplementation. Weight was measured while children were minimally clothed using digital scales. Height was measured using a tape measure while the students were standing in a normal position. The mid-arm circumference was measured while the tape was wrapped loosely around the arm at the mid-point and the measurements were taken to the nearest 0.1 cm.[15] School performances were assessed by grade-point averages of each student. For evaluating the mental function two psychological tests including the Raven's Coloured Progressive Matrices (CPM) and Wechsler Intelligence Scale for children (verbal, non-verbal, total IQ) were conducted on students. The Raven's CPM is internationally recognized as a culture-fair or culture reduced test of non-verbal intelligence for young children.[16] Validity and reliability of CPM has been mentioned before.[17] Intelligence Scale for children test (WISC) is an individually administered intelligence test for children between the ages of 6 and 16 inclusively that can be completed without reading or writing. Validity and reliability of this test is also mentioned previously.[18]

Milk supplementation: Tetra-pack sterilized and homogenized milk was distributed daily for three months (250 ml for each student) from December to March. The fat content of milk was 2.5%. Milk was consumed by the first to third class students in the primary school under supervision of the teachers at the first rest time of the primary school at 9:30 a.m. Some students refrained from taking milk at the beginning, but nutrition education by the teachers and some of the more interested students through discussion, posters, and wall papers solved this problem at the first week of this population trial. So, within two weeks all the students were taking their milk. During the three months period, two more meetings were held with the parents to discuss further about the benefits of dairy intake. At the end of the three months period, anthropometric data, psychological tests and data regarding the school performance were gathered again. There were no reports of not consuming milk from the intervention schools.

Statistical Methods: We used paired t-tests to globally compare means of all quantitative variables before and at the end of the study in each of the intervention and the control group (within each group). Furthermore, two-independent samples t-test was used for comparing the mean of variables between the intervention and the control group (between groups). Results were considered significant if the two-tailed p value was < 0.05. Statistical analyses were performed using the Statistical Package for Social Science (SPSS) for Windows version 13.0 (SPSS, Chicago IL).

Results
Table 1 shows the socio-demographic characteristics of the intervention and the control groups. Regarding the parents' occupation information, 42% of the fathers had private business, 35% were government employees, 19% were workers, and the rest were unemployed. Mean ± SD age of fathers was 38.7 ± 3.8 year and the mean age of mothers was 32.5 ± 3.1. Most of the students (31.6%) were the first child of the family. Half of the children in this study had gone to kindergarten before the primary school. Breastfeeding was reported as the major method of feeding among the participants. Based on the students report, 10.7% of them had never consumed breakfast. There were 235 children in the intervention and 234 children in the control group.

Anthropometric measurements and mean of the psychological tests, as well as grade-point

Table 1. Socio-demographic characteristics of the students in the present study

Variables	Groups		
	Intervention	Control	Total
Sex (%)			
Boys	54	44	49
Girls	46	56	51
Age (y)			
Age of boys	94.5 ± 11.9	95.5 ± 9.0	94.9 ± 10.7
Age of girls	91.3 ± 11.5	89.9 ± 11.0	90.5 ± 11.4
Having a separate room (%)			
Yes	25	21	22
No	75	79	78
History of going to kindergarten			
Yes	48	49	49
No	52	51	51
History of breast-feeding			
Yes	53	51	52
No	47	49	48
Never eating breakfast (%)	8.9	11.9	10.7

averages before the intervention and after the intervention are presented separately for both groups in table 2. The weight of children was significantly different between the control and the intervention group at the end of the study

among girls. Height was not significantly different between two groups. Mid-arm circumference did not differ significantly between the intervention and the control groups in total population and among boys. Mid-arm circumference was different only among girls. Mean score of psychological tests before the intervention and after the intervention are presented for both groups in table 3. The mean of IQ was significantly different between the control and the intervention groups among boys. Mean of grade-point averages before the intervention and after the intervention are presented for groups in table 4. The grade-point average increased in the intervention group only among girls.

Discussion

Results of the present study showed beneficial effects of milk supplementation on physical and mental function as well as school performances especially among girls. The benefits on the physical function and school performance were specified in female students. This school feeding program presented beneficial outcomes. Schools are the centers of communities

Table 2. Anthropometric indices among students before and after the intervention separately in each group

Variable	Girls (n = 239)		P	Boys (n = 230)		P	Total		P
	Before the study	End of the study		Before the study	End of the study		Before the study	End of the study	
Weight									
Control[*]	20.9 ± 3.7	23 ± 3.8	< 0.05	24.8 ± 4.1	25.1 ± 4.2	< 0.05	22.6 ± 4.4	24.0 ± 4.0	< 0.05
Intervention[**]	23.1 ± 4.0	23.8 ± 4.3	< 0.05	24.6 ± 5.7	24.5 ± 6	NS	23.9 ± 5	24.2 ± 5	< 0.05
P	< 0.05	< 0.05	-	NS	NS	-	< 0.05	NS	-
Height									
Control	122.2 ± 6.8	123.7 ± 6.8	< 0.05	123.5 ± 5.7	125.5 ± 5.6	< 0.05	122.8 ± 6.4	124.5 ± 6.3	< 0.05
Intervention	121.0 ± 6.5	122.7 ± 6.5	< 0.05	123.3 ± 8.3	124.5 ± 8.0	< 0.05	122.3 ± 7.6	123.7 ± 7.4	< 0.05
P	NS	NS	-	NS	NS	-	NS	NS	-
Mid- arm circumference									
Control	17.2 ± 1.4	17.1 ± 1.5	NS	18.4 ± 1.9	18.6 ± 1.8	NS	17.7 ± 1.7	17.8 ± 1.8	NS
Intervention	18.5 ± 1.7	18.6 ± 1.8	NS	18.6 ± 2.1	18.4 ± 2.1	NS	18.2 ± 1.9	18.1 ± 2	NS
P	< 0.05	< 0.05	-	NS	NS	-	NS	NS	-

[§] n=234 in the control group
[**] n=235 in the intervention group
NS: Not significant

Table 3. Average of psychology tests' scores among students before and after the intervention, separately in each group

Variable	Girls (n = 239)			Boys (n = 230)			Total		
	Before the study	End of the study	P	Before the study	End of the study	P	Before the study	End of the study	P
Mean IQ [*]									
Control	102 ± 12	109 ± 14	< 0.05	104 ± 12	110 ± 14	< 0.05	103 ± 12	109 ± 14	< 0.05
Intervention	106 ± 12	112 ± 11	< 0.05	108 ± 13	115 ± 15	< 0.05	107 ± 13	114 ± 14	< 0.05
P	< 0.05	< 0.05	-	NS	< 0.05	-	< 0.05	< 0.05	-
Verbal test score [2]									
Control	81 ± 15	86 ± 15	< 0.05	92 ± 16	96 ± 16	< 0.05	86 ± 16	91 ± 16	< 0.05
Intervention	87 ± 10	95 ± 12	< 0.05	86 ± 12	98 ± 13	< 0.05	86 ± 11	94 ± 13	< 0.05
P	< 0.05	< 0.05	-	< 0.05	< 0.05	-	< 0.05	< 0.05	-
Non-verbal test score [**]									
Control	89 ± 15	95 ± 15	< 0.05	93 ± 14	95 ± 14	< 0.05	90 ± 15	95 ± 15	< 0.05
Intervention	91 ± 9	104 ± 16	< 0.05	88 ± 10	96 ± 13	< 0.05	89 ± 10	100 ± 15	< 0.05
P	< 0.05	< 0.05	-	< 0.05	< 0.05	-	< 0.05	< 0.05	-
IQ score [2]									
Control	84 ± 14	90 ± 15	< 0.05	92 ± 13	94 ± 14	< 0.05	90 ± 15	93 ± 15	< 0.05
Intervention	89 ± 9	99 ± 13	< 0.05	87 ± 10	96 ± 11	< 0.05	88 ± 10	96 ± 13	< 0.05
P	< 0.05	< 0.05	-	< 0.05	< 0.05	-	< 0.05	< 0.05	-

[*] Based on Raven's Coloured Progressive Matrices
[**] Based on Wechsler Intelligence Scale for children test
NS: Not significant

Table 4. Grade-point average among students before and after the intervention separately in each group

Variable	Girls (n = 239)			Boys (n = 230)			Total		
	Before the study	End of the study	P	Before the study	End of the study	P	Before the study	End of the study	P
Grade-point average									
Control	19.5 ± 1.2	19.5 ± 1.3	NS	18.3 ± 3.9	18.8 ± 2.3	NS	18.9 ± 2.0	19.1 ± 2.2	NS
Intervention	18.7 ± 2.1	19.0 ± 2.0	< 0.05	18.8 ± 2.2	18.8 ± 2.6	NS	18.7 ± 2.0	18.9 ± 2.1	NS
P	< 0.05	< 0.05	-	NS	NS	-	NS	NS	-

NS: Not significant

and the teachers are of great assistance in this respect. Therefore, it would be a good place for promoting nutrition. School feeding supplementation could also privilege the suitable dietary habits among children. In the present study there were also educational sessions for parents and teachers and the school principals which could increase the preference of families for dairy consumption.

Two recently school nutrition program demonstrated the major impacts of supplementing diets of Vietnamese primary school children with fortified milk and biscuits[8] as well as regular and fortified milk[9] on weight and height. However, milk supplementation could increase the micronutrients intake and therefore it is mostly a source of micronutrients supply. The results of the present study regarding the weight of students were more pronounced on girls. This might be due to the difference between the age of puberty among male and females. In the age range of the present study population, girls had a more rapid growth; however, this time is not near to the age of puberty among boys. In the present study there was no significant difference between height of the control and the intervention group. This might be due to the short du-

ration of the study. Maybe the long-term trials would show the effect of milk supplementation on children's height. This is exactly the case regarding the results observed in the present study on the mid-arm circumference.

The school feeding program in Vietnam had beneficial effects on mental function and short memory.[9] Another fortified milk supplementation program in Indonesia showed an improvement in the cognitive function. However, some evidence does not support this result.[19,20] In the present study also, milk supplementation significantly improved intelligence quotient, both verbal and non-verbal skills. Nutrient content of milk might be responsible for this improvement.

School performance increased in the intervention group in the present study but only among girls. Considering the results of this part, we should also pay attention to other environmental confounders. Therefore, we cannot attribute all the observed results to milk consumption. However, presences of biases are inevitable in the population intervention programs. So, we can consider the confounders as the limitation of the population interventional studies.

Beverages might be important for gaining energy, macronutrient, and micronutrient quality of overall intake.[21] Compared to other drinks milk frequently occupies a generally weak position in schools, unless it is supported by legislative measures. Nowadays, sugar sweetened beverages are consumed in highly amount worldwide. In terms of availability, fruit juice is the main competitor of milk in schools internationally. There are several reports regarding the association between soft drinks and chronic diseases such as obesity and adiposity among children and adolescents.[22] According to the reports, 56-85% of school aged children in USA consume at least one soft drink daily.[23] Each additional can or glass of sugar-sweetened drink beyond the normal intake could increase the rate of over weight and obesity 1.6 times.[24] However, there are some reports regarding the weight control effects of dairy products.[25]

Beverages, liquids, and dairies are major components of the different dietary patterns. Different dietary patterns might be related to health and disease.[26] Dairy consumption might be associated with chronic diseases.[27] Even, dietary intervention containing high amount of dairy could improve the risk of chronic diseases.[28] Nutrition education plays an important role for encouraging people to follow the healthy dietary pattern. Therefore, nutrition education is recommended according to the health educational models. Previous studies showed successful results regarding the application of health education models.[29] School feeding programs based on healthy food choices could be a suitable method for improving the nutritional status among children.

In the present study, as a limitation, we could not collect the blood samples from students. It is suggested to also collect blood and urine samples before and after school feeding programs in future studies for analyzing the nutritional status further. Collaborative activities of the school principals were the most important strength of the present study.

Conclusions

In conclusion, the results of the present study support the beneficial effects of school feeding programs' focus on milk supplementation on students' physical, mental and school performances in Iran.

Acknowledgement

Conflict of Interests

Authors have no conflict of interests.

Authors' Contributions
KHR, MIH, HH, ARDM, ADJ, MP participated in the design and conducting the study and preparing the manuscript. LA helped to prepare the manuscript, draft and edit the manuscript. All authors read and approved the final manuscript.

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