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ORIGINAL ARTICLE

Effects of dietary intake on cognitive skills of physically challenged children.

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ABSTRACT… Objective: To determine how a child's dietary intake affected their growth and cognitive skills when physically challenged in Faisalabad City, Pakistan. **Study Design:** Cross Sectional Study. **Setting:** Tanzeem ul Lisan, the Government Special Education Center, Al Faisal Markaz e Nabina, and Government National Special Education Center. **Period:** January 2023 to December 2023. **Method:** One hundred special children were selected randomly, face-to-face interviews were conducted, and collected data were analysed using Statistical Package for Social Sciences (SPSS). **Results:** Indicated that male participants aged 10 to 15 years were prominent, whereas 20% each had ADHD, autism, blindness, and deafness. Many participants maintain an active or very active lifestyle despite a significant portion not engaging in regular exercise. Preference for home-cooked meals, moderate consumption of dietary supplements, variation in water intake, and frequency of eating out were found. Respondents' Common issues include difficulty making decisions, remembering personal information, and learning new content. Based on the results, cognitive training programs are recommended to increase awareness among children and their families. **Conclusion:** In the nutshell, results concluded that dietary intake of special children were associated with physical growth and cognitive skills. Majority of the children were not following normal dietary pattern and the chances of micronutrient deficiencies was higher. Results showed that socioeconomic conditions, type of disorder/ disability, low education of parents, awareness about good nutrition were significantly associated with healthy eating habits and physical growth of special children.

Key words: Autism, Awareness, Diet, Information, Nutrition, Special Children.

INTRODUCTION

Cognitive skills refer to the mental capabilities that enable individuals to process information, reason, remember, and relate concepts. These skills encompass a range of functions, including perception, attention, memory, reasoning, and problem-solving. Their importance in daily functioning and learning cannot be overstated, as they are fundamental to how individuals interact with their environment and acquire new knowledge.[1] In developing countries, adequacy of diet has lasting implications for cognitive development, particularly in the intake of iron, iodine, and vitamin A.[2]

Cognitive skills are essential for effective decision-making and problem-solving in everyday life. They allow individuals to analyze situations, evaluate options, and make informed choices. For instance, strong reasoning skills enable a person to assess the validity of information, while good memory aids in recalling important details necessary for tasks such as following directions or managing schedules.[3] Moreover, cognitive skills play a critical role in social interactions and communication. The ability to interpret non-verbal cues, understand context, and engage in meaningful conversations relies heavily on cognitive processing. As such, these skills are vital for personal and professional relationships, contributing to overall well-being and success in various aspects of life.[4]

In education, cognitive skills are foundational to the learning process. They facilitate the acquisition of knowledge and the development of critical thinking abilities. For example, students with strong analytical skills can better understand

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complex subjects, engage in scientific reasoning, and apply concepts across different disciplines.[5] Research has shown that enhancing cognitive skills can lead to improved academic performance. Programs that focus on developing these skills, such as critical thinking and problem-solving, have been linked to higher achievement levels in students. Furthermore, cognitive skills are increasingly recognized as essential for navigating the information-rich environment of the modern world, where the ability to sift through vast amounts of data and discern relevant information is crucial.[6]

Dietary intake plays a crucial role in the cognitive development of children. Research indicates that adequate nutrition is essential for optimal brain function, particularly during the formative years. A study examining the effects of nutrition on cognitive development in children with learning disabilities found that deficiencies in micronutrients can adversely affect memory and learning capabilities.[7] A longitudinal study in Australia explored the associations between early childhood dietary intake and cognitive readiness for school. Findings indicated that higher dietary intake scores at ages 2-3 years were linked to better cognitive and socioemotional outcomes by ages 4-5 years. This suggests that early dietary habits can have lasting effects on cognitive skills, emphasizing the need for interventions that promote healthy eating patterns among children, particularly those with disabilities.[8] Children with developmental disabilities often face unique challenges related to dietary intake, including picky eating and sensory processing issues. A study on dietary behaviors in children with developmental disabilities found that family-style meal services and peer modeling could positively influence dietary intake and behaviors. These interventions are crucial for improving the nutritional status of children with physical challenges, thereby supporting their cognitive development.[9]

In Pakistan, there is a lack of awareness about the problems faced by special children and less literature is available about the dietary patterns and its associated cognitive skills of children with special needs. Due to this situation, special children are mis-diagnosed and go through the wrong treatment which leads to severe illness. Therefore, this study was conducted to assess the effects of dietary intake on cognitive skills of physically challenges children in Faisalabad.

METHODS

The present study was conducted in Faisalabad city after approval from research board (6161-64/14/3/24). With an estimated 3.7 million people living there in 2023 and a growth rate of 2.37%, it is Pakistan's third most populous metropolitan area. The study was conducted in Tanzeem ul Lisan, the Government Special Education Center, Al Faisal Markaz e Nabina, and Government National Special Education Center. The data was collected and analyzed from 100 special children living in Faisalabad city were selected randomly to assess their dietary intake. 5 different disabilities were targeted. With each disability, 20 study participants from different age groups were selected.

The inclusion criteria for the respondents were:

- Special Children
- Children with Autism, Deaf, ADHD, Blind, Physical disabled
- Permanent residence in Faisalabad
- Age limit 4-15 years
- Willing to participate

The exclusion criteria was:

- Normal children
- Children having other disabilities
- Did not have residence in Faisalabad
- Above 15 or below 4 years
- Not willing to participate

Data was collected using a questionnaire created with the help of literature. Questionnaire consist of eight different questions having different parts. In-depth face-to-face interviews were conducted on the study objects selected according to the inclusion criteria.

Before conducting interviews, the study was briefed to all the participants, and after they had permitted participation, the interviews were started. They were assured that their data will not be shared with anybody and it will remain

confidential. Their identities will also remain confidential and they can quit the study at any time before submitting information.

All the results collected was subjected to SPSS version 22. Descriptive statistics were applied to evaluate data. For univariate analysis frequency distribution was used. Bivariate analysis was used for chi-square and Fischer's exact test.

RESULTS

Table-I provides demographic and categorical data of individuals based on age, gender, disability, class, and learning group. The age distribution shows that 46% of the individuals are between 4 to 10 years old, while 54% are between 10 to 15 years old. Gender-wise, 32% are female and 68% are male. Regarding disabilities, the distribution is even, with 20% having ADHD, 20% having autism, 20% being blind, and 20% being deaf.

In terms of class distribution, 20% are classified as physically disabled. The remaining individuals are spread across various grades: 1st and 2nd grades each have 3%, 3rd grade has 5%, 4th grade has 11%, 5th grade has 5%, 6th grade has 3%, 7th grade has 4%, 8th and 9th grades each have 8%, and 10th grade has 10%. Additionally, 20% have no schooling, 11% are in a learning group, and 9% are in a nursery.

Table-II summarizes data on recent weight changes and allergies among individuals. Regarding weight changes, 11% have experienced recent weight gain, 26% have experienced weight loss, and 63% have not had any recent weight changes. Regarding allergies, 13% are allergic to dust, 5% to nuts, 5% to pollen, and 2% to skin-related allergens, while 74% have no allergies and 1% have unspecified allergies.

Table-III details lifestyle and exercise habits among individuals. Regarding lifestyle, 36% lead an active lifestyle, 15% have a moderate lifestyle, 15% are passive, and 34% are very active. Regarding regular exercise, 56% do not exercise regularly, while 44% do. Among those who exercise, 1% jog, 13% jump, 2% participate in race or skipping, 2% do race and squats, 4% run, 15% perform sit-stand exercises, 5% skip, 1% do squats, and 1% walk. The duration of exercise varies, with 19% exercising for 10 minutes, 14% for 15 minutes, 1% for 2-3 minutes, 1% for 20 minutes, 7% for 5 minutes, 1% for 5-6 minutes, and 1% for 8 minutes, while 56% do not exercise.

Category	Frequency (%)
Age	
4 to 10 years	46 (46.0%)
10 to 15 years	54 (54.0%)
Gender	
Female	32 (32.0%)
Male	68 (68.0%)
Disability	
ADHD	20 (20.0%)
Autism	20 (20.0%)
Blind	20 (20.0%)
Deaf	20 (20.0%)
Class	
Physically Disabled	20 (20.0%)
1st	3 (3.0%)
2nd	3 (3.0%)
3rd	5 (5.0%)
4rth	11 (11.0%)
5th	5 (5.0%)
6th	3 (3.0%)
7th	4 (4.0%)
8th	8 (8.0%)
9th	8 (8.0%)
10th	10 (10.0%)
No schooling	20 (20.0%)
Learning Group	11 (11.0%)
Nursery	9 (9%)

Table-I. Frequency distribution about the personal information.

Variables	Category	Frequency (%)
Recent weight gain/loss	Gain	11 (11.0%)
	Loss	26 (26.0%)
	No	63 (63.0%)
Any allergy	dust	13 (13.0%)
	no	74 (74.0%)
	Nuts	5 (5.0%)
	Pollen	5 (5.0%)
	Skin	2 (2.0%)
	yes	1 (1.0%)

Table-II. Frequency distribution about the anthropometric measurements.

Variables	Category	Frequency (%)
Type of lifestyle	Active	36 (36.0%)
	Moderate	15 (15.0%)
	Sedentary	15 (15.0%)
	Very Active	34 (34.0%)
Do you do regular exercise	No	56 (56.0%)
	Yes	44 (44.0%)
If yes than Frequency	Jogging	1 (1.0%)
	Jumping	13 (13.0%)
	No	56 (56.0%)
	Race, Skipping	2 (2.0%)
	Race, Squats	2 (2.0%)
	Running	4 (4.0%)
	Sit stand	15 (15.0%)
	skipping	5 (5.0%)
	Squats	1 (1.0%)
	Walk	1 (1.0%)
Duration	10 mins	19 (19.0%)
	15 mins	14 (14.0%)
	2-3 mins	1 (1.0%)
	20 mins	1 (1.0%)
	5 mins	7 (7.0)
	5-6 mins	1 (1.0%)
	8 mins	1 (1.0%)
	No	56 (56.0%)

Table-III. Frequency distribution about the physical activity level.

Table-IV presents data on diagnosis, medication use, and other diseases among individuals. For diagnoses, 20% have ADHD and another 20% have autism. Additionally, 9% are completely blind, 11% are partially blind, 3% use hearing aids, and 3% are hearing impaired. Other diagnoses include profound hearing loss (10%), severe hearing loss (4%), and various physical disabilities such as right-hand amputation (1%), right-side paralysis (2%), no arms (2%), no hands (1%), no left arm (2%), no right arm (2%), and issues with one foot (1%), left arm and leg (1%), and walking (6%). There are also finger problems (1%) and speech issues (1%).

Regarding medication, 2% take epival, 1% use inhalers, 13% are on unspecified medicines, and 84% do not take any medication. In terms of other diseases, 3% have asthma, 1% each has ADHD, epileptic fits, fits, flu (reported twice), migraine, tonsils (2%), and typhoid. A significant majority, 88%, reported having no other diseases.

Variables	Category	Frequency (%)
Diagnosis	ADHD	20 (20.0%)
	Autism	20 (20.0%)
	Complete Blind	9 (9.0%)
	Fingers problem	1 (1.0%)
	hearing aid	3 (3.0%)
	Hearing Impaired	3 (3.0%)
	Left Arm and Leg issue	1 (1.0%)
	No arms	2 (2.0%)
	No hands	1 (1.0%)
	No left arm	2 (2.0%)
	No right Arm	2 (2.0%)
	One foot issue	1 (1.0%)
	Partial Blind	11 (11.0%)
	Profound Hearing	10 (10.0%)
	Right hand amputed	1 (1.0%)
	Right Side Paralyzed	2 (2.0%)
	Severe Hearing Loss	4 (4.0%)
	Speech Issue	1 (1.0%)
	Walking Issue	6 (6.0%)
Medication	epival	2 (2.0%)
	Inhaler	1 (1.0%)
	No	84 (84.0%)
	yes	13 (13.0%)
Any other disease	ADHD	1 (1.0%)
	Asthma	3 (3.0%)
	Epileptic fits	1 (1.0%)
	Fits	1 (1.0%)
	flu	1 (1.0%)
	Flu	1 (1.0%)
	Migraine	1 (1.0%)
	No	88 (88.0%)
	Tonsils	2 (2.0%)
	Typhoid	1 (1.0%)

Table-IV. Frequency distribution of the medical history.

Table-V provides information on dietary supplement usage, eating habits, and water consumption. Regarding dietary supplements, 72% of individuals do not take any, while 28% do. Among those who take supplements, 10% use calcium, 11% take iron, 2% use Surbex Z, and 5% take vitamin D. In terms of eating out or ordering takeout, 38% do so 2-3 times a week, 16% do so 4-5 times, 5% do so daily, and 41% rarely eat out. Regarding eating cooked meals at home, 52% always eat home-cooked meals, 10% do so occasionally, and 38% do so often. Water consumption varies, with 32% drinking 2 to 3

glasses per day, 36% drinking 3 to 5 glasses, and 32% drinking 6 to 7 glasses daily. The prevalence of dietary supplement use among pharmacy students in Karachi, Pakistan, was 48.2%, with 51% in males and 47.3% in females.[10] Moreover, Dietary supplements use among students is a common phenomenon and slightly conditioned by eating behaviors.[11]

Variables	Category	Frequency (%)
Do you take any dietary supplements or vitamins regularly	No	72 (72.0%)
	Yes	28 (28.0%)
If yes then specify	Calcium	10 (10.0%)
	Iron	11 (11.0%)
	No	70 (70.0%)
	Surbex Z	2 (2.0%)
	Vitamin D	5 (5.0%)
How often do you eat out or order takeout in a typical week	2-3 times	38 (38.0%)
	4-5 times	16 (16.0%)
	Daily	5 (5.0%)
	Rarely	41 (41.0%)
How often do eat cooked meals at home	Always	52 (52.0%)
	Occasionally	10 (10.0%)
	Often	38 (38.0%)
On average, how many glasses of water do you drink per day	2 to 3 glass	32 (32.0%)
	3 to 5 glass	36 (36.0%)
	6 to 7 glass	32 (32.0%)

Table-V. Frequency distribution of the dietary assessment.

Table-VI presents data on the frequency of meals and various food consumption habits. In a typical week, 75% of individuals take breakfast daily, 11% five times, 9% six times, 4% four times, and 1% three times. For lunch, 59% have it daily, 17% five times a week, 7% four times, 6% three times, 6% six times, 4% twice, and 1% once. Regarding dinner, 86% have it daily, 10% six times a week, and 4% five times. Dietary fiber is positively associated with cognitive control in children aged 7-9 years.[12] A healthier dietary pattern in early childhood is associated with better cognitive outcomes in young children.[13] Children's early dietary intake plays an important role in their cognitive skills, which are critical school readiness indicators.

Regarding specific food items, 83% eat chapatti daily, 12% four to five times a week, and 5% two to three times. Rice is consumed by 48% twice to three times a week, 10% four to five times, and 42% once weekly. Dairy products are consumed daily by 48%, 28% two to three times a week, 17% four to five times, 5% once, and 2% rarely. Fruits are eaten daily by 24%, 29% two to three times a week, 21% four to five times, 19% once, and 7% rarely. Eggs are consumed daily by 39%, 40% two to three times a week, 8% four to five times, and 13% once. Nutritional interventions like iron and multiple-micronutrient supplementation improve cognitive abilities of undernourished preschool-age children, while increased fish consumption benefits nourished children.[14]

Chicken is eaten daily by 44%, 18% two to three times a week, 13% four to five times, 23% once, and 2% rarely. Mutton or beef is eaten rarely by 45%, 35% once a week, 18% two to three times, 1% four to five times, and 1% rarely. Vegetables are consumed daily by 27%, 38% two to three times a week, 24% four to five times, 8% once, and 3% rarely. Desserts are eaten daily by 17%, 28% two to three times a week, 14% four to five times, 34% once, and 7% rarely.

Junk food is consumed daily by 32%, 24% two to three times a week, 12% four to five times, 26% once, and 5% rarely. Beverages such as soft drinks and juice are consumed daily by 21%, 38% two to three times a week, 15% four to five times, 22% once, and 4% rarely.

Table-VII presents the mean and standard deviation (S.D.) of various difficulties related to cognitive and memory functions. The difficulty of reading something without thinking and needing to read it again has a mean of 3.36 (SD: 1.37). Difficulty remembering personal information like date of birth or home address has a mean of 3.52 (SD: 1.14). Difficulty noticing road signs has a mean of 3.62 and an S.D. of 1.23. Difficulty judging distance, size, or direction has a mean of 3.35 and an S.D. of 1.15. Bumping into other people has a mean of 3.12 (SD: 1.34). Difficulty remembering where things are placed has a mean of 3.63 (SD: 1.19).

Variables	Category	Frequency (%)
How many times you take breakfast in a week	3	1 (1.0%)
	4	4 (4.0%)
	5	11 (11.0%)
	6	9 (9.0%)
	7	75 (75.0%)
Lunch in a week	1	1 (1.0%)
	2	4 (4.0%)
	3	6 (6.0%)
	4	7 (7.0%)
	5	17 (17.0%)
	6	6 (6.0%)
	7	59 (59.0%)
Dinner in a week	5	4 (4.0%)
	6	10 (10.0%)
	7	86 (86.0%)
How often do you eat Chapatti	2-3 times	5 (5.0%)
	4-5 times	12 (12.0%)
	Daily	83 (83.0%)
How often do you eat rice	2-3 Time	48 (48.0%)
	4-5 times	10 (10.0%)
	Once a week	42 (42.0%)
How often do you eat dairy products (milk, yogurt, tea)	2-3 times	28 (28.0%)
	4-5 times	17 (17.0%)
	Daily	48 (48.0%)
	Once	5 (5.0%)
	rarely	2 (2.0%)
How often do you eat fruits	2-3 times	29 (29.0%)
	4-5 times	21 (21.0%)
	Daily	24 (24.0%)
	Once	19 (19.0%)
	Rarely	7 (7.0%)
How often do you eat eggs	2-3 times	40 (40.0%)
	4-5 times	8 (8.0%)
	Daily	39 (39.0%)
	once	13 (13.0%)
How often do you eat chicken	2-3 times	18 (18.0%)
	4-5 times	13 (13.0%)
	Daily	44 (44.0%)
	Once	23 (23.0%)
	Rarely	2 (2.0%)
How often do you eat mutton or beef	2-3 times	18 (18.0%)
	4-5 times	1 (1.0%)
	once	35 (35.0%)
	rarely	1 (1.0%)
	Rarely	45 (45.0%)
How often do you eat vegetables	2-3 times	38 (38.0%)
	4-5 times	24 (24.0%)
	Daily	27 (27.0%)
	Once	8 (8.0%)
	rarely	3 (3.0%)
How often do you eat Desserts	2-3 times	28 (28.0%)
	4-5 times	14 (14.0%)
	Daily	17 (17.0%)
	Once	34 (34.0%)
	Rarely	7 (7.0%)
How often do you eat Junk food	2-3 times	24 (24.0%)
	2-3 tmes	1 (1.0%)
	4-5 times	12 (12.0%)
	Daily	32 (32.0%)
	Once	26 (26.0%)
	Rarely	5 (5.0%)
How often do you take beverages (Soft drinks, juice etc)?	2-3 times	38 (38.0%)
	4-5 times	15 (15.0%)
	Daily	21 (21.0%)
	Once	22 (22.0%)
	Rarely	4 (4.0%)

Table-VI. Frequency distribution of the food frequency.

Difficulty learning rhymes, songs, and multiplication tables have a mean of 3.49 (SD: 1.19). Failing to listen to people's names when meeting them has a mean of 3.56 (S.D: 1.23). Trouble making up the mind has a mean of 3.62 (SD: 1.22). Blurting out socially inappropriate comments has the highest mean of 3.71 (SD: 1.34). Difficulty remembering appointments or homework has a lower mean of 2.68 (SD: 1.37). Difficulty remembering faces has a mean of 3.20 (SD: 1.26). Daydreaming during class has a mean of 3.52 and an S.D. of 1.14, while doing things abruptly has a mean of 3.63 (SD: 1.25).

	Mean	S.D
Read something but not think about it and must read it again	3.36	1.37
Difficulty remembering information about personal data, such as date of birth, home address etc	3.52	1.14
Difficult to notice signs on the road	3.62	1.23
Difficulty judging distance, size or direction	3.35	1.15
Bumps into other people	3.12	1.34
Difficulty in remembering where he/she put things	3.63	1.19
Difficulty learning rhymes, songs, multiplication tables etc	3.49	1.19
Fails to listen to peoples name when meeting with them	3.56	1.23
Trouble in making up the mind?	3.62	1.22
Blurts out socially inappropriate comments	3.71	1.34
Difficulty remembering appointments with peers or homework	2.68	1.37
Difficulty remembering the faces of other people	3.20	1.26
Seems like daydreaming during class	3.52	1.14
Does things abruptly	3.63	1.25

Table-VII. Cognitive skills.

How Often Do You Eat Vegetables * Read Something but Not Thinking About It and Must Read Again Crosstabulation							
		Read Something but Not Thinking About It and Must Read Again					Total
		Never	Occasionally	Quiet often	Rarely	Very often	
How Often Do You Eat Vegetables	2-3 times	5	8	1	18	6	38
	4-5 times	1	9	1	8	5	24
	Daily	3	7	4	6	7	27
	Once	0	3	1	4	0	8
	rarely	0	0	1	1	1	3
Total		9	27	8	37	19	100

Table-VIII. Table of association between how often you eat vegetable* read something but not thinking about it.
Chi-square value/Fisher Exact test value = 16.53 p-value = 0.015

Trouble In Making Up the Mind? * How Many Times You Take Breakfast in A Week Crosstabulation							
		How Many Times You Take Breakfast in A Week					Total
		3	4	5	6	7	
Trouble in making up the mind?	Never	0	1	4	2	25	32
	Occasionally	0	2	0	1	6	9
	Quiet often	0	1	2	2	11	16
	Rarely	1	0	0	1	14	16
	Very often	0	0	5	3	19	27
Total		1	4	11	9	75	100

Table-IX. Table of association between trouble in making up the mind* how many times you take breakfast in a week
Chi-square value/Fisher Exact test value = 12.43 p-value = 0.021

Table-IX explores the relationship between the frequency of breakfast consumption per week and the incidence of having trouble making up one's mind. Among those who take breakfast 3 times a week, 1 person rarely has trouble making up their mind. For individuals who have breakfast 4 times a week, 1 person never, 2 occasionally, and 1 quite often experiences this issue. Among those who eat breakfast 5 times a week, 4 never, 2 quite often, and 5 very often have trouble making up their mind. Of those who have breakfast 6 times a week, 2 never, 1 occasionally, 2 quite often, 1 rarely, and 3 very often struggle with making decisions. Lastly, among individuals who take breakfast every day, 25 never, 6 occasionally, 11 quite often, 14 rarely, and 19 very often have trouble making up their mind. Out of 100 respondents, 32 never, 9 occasionally, 16 quite often, 16 rarely, and 27 very often experience trouble making up their mind. This table provides insight into how the regularity of breakfast consumption might correlate with the frequency of decision-making difficulties.

DISCUSSION

The research highlights the participants' diverse demographic profile and various lifestyle, dietary, and cognitive patterns. Most individuals are in the 10 to 15-year age group and predominantly male. There is a balanced representation of disabilities, with ADHD, autism, blindness, and deafness each affecting 20% of the population. Education levels vary significantly, with a notable portion of individuals without formal schooling. Lifestyle data indicates a significant portion of the population does not exercise regularly, though many maintain an active or very active lifestyle. Dietary habits show a preference for home-cooked meals and a moderate consumption of dietary supplements, while water intake and the frequency of eating out vary. Cognitive and memory difficulties are prevalent, with participants frequently experiencing issues such as difficulty in making decisions, remembering personal information, and learning new content. Socially inappropriate behavior and abrupt actions are also noted, indicating potential areas for behavioral intervention. There is need to implement targeted cognitive training programs to address the prevalent issues with memory, decision-making, and learning new content. This could involve techniques like mnemonic devices, visual aids, and interactive learning modules. Initiatives should be initiated to promote regular

exercise among individuals, emphasizing the benefits of physical activity for both physical and mental health.

CONCLUSION

In the nutshell, results concluded that dietary intake of special children were associated with physical growth and cognitive skills. Majority of the children were not following normal dietary pattern and the chances of micronutrient deficiencies was higher. Results showed that socioeconomic conditions, type of disorder/ disability, low education of parents, awareness about good nutrition were significantly associated with healthy eating habits and physical growth of special children.

CONFLICT OF INTEREST

The authors declare no conflict of interest.

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