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THE EFFECT OF PROBIOTIC USE ON BODY MASS INDEX AND GASTROINTESTINAL SYSTEM PROBLEMS IN OVERWEIGHT AND OBESE WOMEN WHO FOLLOW A WEIGHT-LOSS DIET

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ABSTRACT

Objective: *Obesity is a medical condition which arises as a result of unhealthy eating behaviours and poor diet quality that negatively impacts energy intake, consumption, and storage. The objective of the present study was to examine the effect of 8-week probiotic use on Body Mass Index (BMI) and gastrointestinal system problems in overweight and obese women who follow a weight-loss diet.*

Material and Method: *34 women with a BMI above 25 kg/m^2 participated in this study. Both the study group (17 women-mean age 32.4±7.3) and control group (17 women-mean age 31.8±8.9) were given a weight loss diet (personalized diet according to the daily energy needs of the participants), exercise program (brisk walk for 30-50 minutes, 3-5 days a week) for eight weeks. In addition, the study group received oral probiotic support in this process. BMI and the frequency of gastrointestinal system problems such as constipation, gas, bloating, and indigestion in both groups were evaluated statistically at the initial, 4th and 8th weeks.*

Results: *BMI and gastrointestinal system problems of both groups were evaluated during 8 weeks of follow-up. At the beginning of the study and the 4th and 8th weeks were statistically significant for weight loss ($p<0.05$). At the end of the 4th week of the study, 70.6% of the study group and 41.2% of the control group did not experience any postprandial gas problem. At the end of the 4th week, regarding the postprandial gas problem, the results of the chi-square test performed between the two groups were statistically significant ($p<0.05$).*

Conclusion: *It was concluded that diet and exercise were effective in weight loss in both groups and the use of probiotics can relieve postprandial gas problems.*

Keywords: *Body mass ındex, probiotics, weight loss, obesity, follow-up studies.*

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PROBİYOTİK KULLANIMININ FAZLA KİLOLU VE OBEZ KADINLARDA BEDEN KİTLE İNDEKSİNE VE GASTROİNTESTİNAL SİSTEM SORUNLARINA ETKİSİ

ÖZET

Amaç: Obezite, sağlıksız beslenme davranışları ve kötü beslenme sonucu ortaya çıkan, enerji alımını, tüketimini ve depolanmasını olumsuz yönde etkileyen tıbbi bir sorundur. Bu çalışmanın amacı, kilo verme diyeti uygulayan fazla kilolu ve obez kadınlarda 8 haftalık probiyotik kullanımının Beden Kitle İndeksi (BKİ) ve gastrointestinal sistem sorunları üzerindeki etkisini incelemektir.

Materyal ve Metot: Bu çalışmaya BKİ değeri 25 kg/m^2'nin üzerinde olan 34 kadın katılmıştır. Hem çalışma grubuna (17 kadın-yaş ortalaması 32,41±7,25) hem de kontrol grubuna (17 kadın-yaş ortalaması 31,76±8,86) kilo verme diyeti (katılımcıların günlük enerji ihtiyacına göre kişiye özel diyet), egzersiz programı (8 hafta boyunca, haftada 3-5 gün, 30-50 dakika tempolu yürüyüş) verilmiştir. Ayrıca çalışma grubu bu süreçte oral probiyotik desteği almıştır. Her iki grupta kabızlık, gaz, şişkinlik ve hazımsızlık gibi gastrointestinal sistem sorunlarının görülme sıklığı başlangıç, 4. ve 8. haftalarda istatistiksel olarak değerlendirilmiştir.

Bulgular: Her iki grubun BKİ ve gastrointestinal sistem sorunları 8 haftalık takipte değerlendirilmiştir. Çalışmanın başında, 4. ve 8. haftalarda yapılan ölçümlerde kilo kayıpları istatistiksel olarak anlamlı bulunmuştur ($p<0,05$). Çalışmanın 4. haftası sonunda çalışma grubunun %70,6'sı, kontrol grubundakilerin ise %41,2'si gaz sorunu yaşamamıştır. Dördüncü hafta sonunda, postprandiyal gaz sorunu açısından iki grup arasında yapılan ki-kare testi sonuçları istatistiksel olarak anlamlı bulunmuştur ($p<0,05$).

Sonuç: Diyet ve egzersizin her iki grupta da kilo vermede etkili olduğu ve probiyotik kullanımının postprandiyal gaz problemini giderebileceği sonucuna varılmıştır.

Anahtar kelimeler: Beden kitle indeksi, probiyotikler, kilo kaybı, obezite, takip çalışmaları.

INTRODUCTION

Obesity is a medical condition that is associated with unhealthy eating behaviours and poor diet quality that negatively affects energy intake, consumption, and storage.[1,2] The World Health Organization (WHO) estimated that the number of obese adults had increased more than sevenfold in the last 40 years. Body mass index (BMI) is a measurement for classifying "body weight" by height. BMI measures the ratio of an individual's body weight divided by the square of his or her height. BMI ranges for overweight, and obesity are 25–29.9 and ≥30 kg/m^2, respectively.[3-8] High BMI is an important risk factor for cardiovascular diseases, diabetes, cancers, and musculoskeletal disorders.[9,10] The human body contains many microorganisms, including a large number of bacteria, fungi, and protozoa, which are referred to as the microbiota.[11] There is a relationship between obesity and gut microbiota. Studies in diabetic rats have shown that probiotic consumption increased the bioavailability of oral antidiabetic agents.[12-14] In recent years dietary intervention with probiotics and prebiotics aimed at improving the gut microbiota was observed in obesity.[15] Early in life, the gastrointestinal tract becomes colonized by microbes, and the gut microbiota reaches an adult state at 3 years of age. Bacteroidetes and Firmicutes form more than 90% of the total microbial population in humans. The gut microbiota can constitute an environmental factor in the pathogenesis of obesity. Recent studies discovered that a large number of Lactobacillus, Bifidobacterium, Saccharomyces, Streptococcus, and Enterococcus supplementation in the diet might play a crucial role in preventing obesity. The mechanisms of action in obesity treatment by probiotics: decreased contagious microorganism growth, increased intestinal mucus layer production and modulation of the immune system.[16-18]

This study aims to examine the effect of 8-week probiotic use on BMI and the frequency of gastrointestinal system problems such as constipation, gas, bloating, and indigestion in overweight and obese women who follow a weight-loss diet and exercise program.

MATERIAL AND METHOD

Study design

This randomized controlled trial was conducted at Emek Hospital in Gaziantep, Turkiye between December 2020 and June 2021. The protocol for this trial and CONSORT checklist are available as supporting information (Figure 1). Forty women who were followed up in the Nutrition and Diet Clinic were assessed for eligibility. Participants who are between the ages of 19-50, not in the period of pregnancy, lactation and menopause, who have a BMI of 25 kg/m^2 or above, absence of any chronic or inflammatory disease except

obesity, and do not smoke, use alcohol, any antidiabetic agent, antibiotic and dietary supplements in the last 3 months were included in the research. Insulin resistance is not an exclusion criterion. Individuals accepted to participate in the study were randomly selected into study and control groups. However, the study was completed with a total of 34 people, due to the pandemic process that emerged after the beginning of the study, failure to attend face-to-face interviews with the dietitian or failure to obtain the necessary parameters. For eight weeks, the study group (n=17) was given a weight-loss diet, exercise program and probiotic dietary supplements; The control group (n=17) was given a weight-loss diet and an exercise program without probiotic dietary supplements. Participants in both groups were advised to brisk walk for 30-50 minutes 3-5 days a week. The nutritional instructions were developed based on the Dietary Reference Intakes published by The Turkish Ministry of Health. The participants in the study group were given an oral probiotic dietary supplement containing various probiotic strains in the amount of $1.5x10^9$ cfu/g in each capsule, twice a day. BMI of the individuals and the frequency of gastrointestinal system problems such as constipation, gas, bloating, and indigestion in both groups were evaluated statistically at the beginning, 4th and 8th weeks. The personalized diet planning of the women participating in the study was arranged according to their daily energy needs. Basal metabolic rates of individuals participating in the study were calculated using the Mifflin-St Jeor equation.[19] When calculating the total energy requirement of individuals, first of all, physical activity level (PAL) values were calculated.[20] The total energy requirement of the individual was calculated by multiplying the PAL value found with the basal metabolic rate value.[21]

Probiotic Dietary Supplement

The probiotic dietary supplement preferred and used within the scope of the research was obtained from the pharmacy and given to the participants by the researcher. The probiotic dietary supplement (NBL Probiotic Optima) contains 6 different bacterial strains in a total amount of $1.5x10^9$ cfu/g for each tablet. The strain codes in the probiotic capsule are specified as Enterococcus faecium CBT EF4, Lactobacillus plantarum CBT LP3, Streptococcus thermophilus CBT ST3, Bifidobacterium lactis CBT BL3, Lactobacillus acidophilus CBT LA1 and Bifidobacterium longum CBT BG7. In addition, each capsule contains fructooligosaccharides (225 mg). In addition, this oral probiotic contains 30 mg of vitamin C in each tablet. The factor in choosing this probiotic is that it is highly accessible in Turkiye. Participants used probiotic dietary supplement tablets twice a day, in the morning and the evening, for 8 weeks (56 days), taking into account the information obtained from the literature.

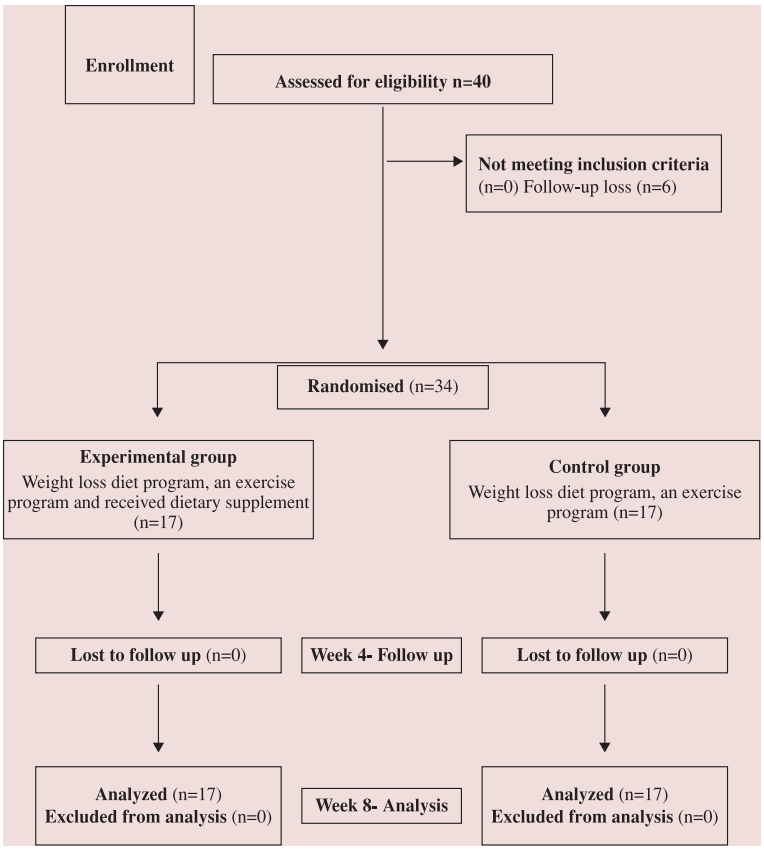

Figure 1. Participant flow in CONSORT-recommended form.

Ethics Clearance

All data collection protocols and research designs were approved by the Sanko University Medical Faculty Ethics Committee (2020/15-01). All women received oral and written information and signed informed consent. The study was carried out in compliance with the Helsinki Declaration.

Statistical Analysis

Statistical analysis was performed with SPSS version 22.0 (SPSS Inc., Chicago, IL, USA). BMI data of the study populations were given as Means±Standard Deviation (SD). To check the normality of the data distribution Shapiro-Wilk test was performed. The student's t-test was used to compare two independent measurements with normal distribution, and the Mann-Whitney U test was used to compare two independent measurements that were not normally distributed. Friedman's two-way analysis of variance and Chi-square test were used to determine whether there was a significant difference between the two groups in terms of sociodemographic characteristics and gastrointestinal problems. $p<0.05$ were considered statistically significant.

Table 1. Distribution of anthropometric measurements of women by groups at the beginning of the study, at 4 weeks and the end of 8 weeks.

Anthropometric measurements	Phase	Experimental		Control		Total		*p* values
		$\bar{\chi} \pm S$	Median	$\bar{\chi} \pm S$	Median	$\bar{\chi} \pm S$	Median	
Body weight (kg)	Initial	85.24±10,05^{C}	83.4	83.48±12.67^{C}	81.1	84.36±11.3^{C}	83.25	0.375
	4th week	81.33±10,08^{B}	80.2	78.83±12.07^{B}	75.5	80.08±11.02^{B}	79.85	0.357
	8th week	79.25±9,99^{A}	78.3	76.24±11.9^{A}	72.8	77.74±10.93^{A}	77.6	0.274
	p value	0.001*		0.001*		0.001*		
BMI (kg/m^2)	Initial	33.04±3.2^{C}	32.9	32.07±4.57^{C}	31.5	32.56±3.92^{C}	32.2	0.479
	4th week	31.28±3.31^{B}	30.8	30.43±4.63^{B}	29.4	30.86±3.99^{B}	30.4	0.541
	8th week	30.52±3.23^{A}	30.3	29.43±4.55^{A}	28.7	29.98±3.92^{A}	29.3	0.425
	p value	0.001*		0.001*		0.001*		
Waist/Hip (cm)	Initial	0.88±0.07	0.88	0.9±0.1	0.91	0.89±0.09^{B}	0.91	0.509
	4th week	0.88±0.07	0.88	0.9±0.1	0.91	0.89±0.09^{B}	0.91	0.518
	8th week	0.88±0.08	0.86	0.9±0.1	0.9	0.89±0.09^{A}	0.90	0.484
	p value	0.068		0.056		0.004*		

ǂ Student's t test and repeated measure analysis of variance, ₸Mann Whitney U test and Friedman two-way analysis of variance, A, B, C are significantly different from each other, *p<0.05

Table 2. Constipation status and incidence of constipation at the start of the study

		Experimental		Control		Total		*p*
		n	%	n	%	n	%	
Constipation problem	Yes	6	35.3	10	58.8	16	47.1	0.385
	No	3	17.6	2	11.8	5	14.7	
	Sometimes	8	47.1	5	29.4	13	38.2	
Constipation, if yes, how often	Everyday, 5-6 per week	6	42.9	5	33.3	11	37.9	0.508
	1-4 per week	8	57.1	10	66.7	18	62.1	

Chi-square test was used, statistically significant as *p< 0.05

Table 3. Constipation status and incidence of constipation at 4 weeks of the study.

		Experimental		Control		Total		*p*
		n	%	n	%	n	%	
Constipation problem	Yes	0	0.0	5	29.4	5	14.7	0.013*
	No	3	17.6	4	23.5	7	20.6	
	Sometimes	14	82.4	8	47.1	22	64.7	
Constipation, if yes, how often	Everyday, 5-6 per week	0	0.0	0	0.0	0	0.0	0.937
	1-4 per week	14	51.9	13	48.1	27	100.0	

Chi-square test was used, statistically significant as *p< 0.05

RESULTS

The mean age of the study group was 32.41±7.25, while the mean age of the control group was 31.76±8.86 years, and the difference between the two groups was not statistically significant (p>0.05). Anthropometric measurements were given in Table 1. In terms of weight loss, the measurements of the study group at the beginning of the study at the 4th and 8th weeks were statistically significant respectively (85.24±10.05; 81.33±10.08; 79.25±9.99 (p=0.001). The BMI of the participants decreased in the 4th and 8th months compared to the baseline. The weight loss values of both the study group and control group were significant at 4 and 8 weeks compared to baseline (study group: 85.24±10.05; 81.33±10.08; 79.25±9.99 (p=0.001). Control group: 83.48±12.67; 78.83±12.07; 76.24±11.9 (p=0.001). In both groups, the waist/hip ratio of the participants did not decrease at 4 and 8 months compared to baseline. The waist/hip ratio measurements of the control group at the beginning of the study (0.9±0.1), at the 4th (0.9±0.1) and 8th (0.9±0.1) weeks were not statistically significant (p>0.05). The waist/hip ratio measurements of the study group at the beginning of the study (0.88±0.07), at the 4th (0.88±0.07) and 8th (0.88±0.08) weeks were not statistically significant (p>0.05)

The distribution of women regarding their constipation status and the frequency of constipation at the beginning of the study is given in Table 2. At the beginning of the study, 35.3% of the study group and 58.8% of the control group had constipation problems.

According to Table 3, at the end of the 4th week of the study, 82.4% of the study group and 47.1% of the control group had sometimes constipation problems.

Table 4 shows that at the end of the 8th week, 58.8% of the study group did not have constipation problems, while 58.8% of the control group had sometimes constipation problems.

Postprandial gas, bloating and indigestion problems in both groups at the beginning of the study were given in Table 5. Before the probiotic was given yet, according to the Initial findings: 47.1% of the study group and 52.9% of the control group had sometimes gas problems after meals. Also, 52.9% of the study group experienced sometimes postprandial bloating. Besides, 64.7% of the study group and 58.8% of the control group had postprandial digestive problems.

In table 6, at the end of the 4th week of the study, 70.6% of the study group and 41.2% of the control group did not have any postprandial gas problem. Furthermore, 58.8% of the study group did not have postprandial digestive problems, 47.1% of the control group had sometimes postprandial digestive problems

Table 7 shows postprandial gas, bloating and indigestion problems in the 8th week of the study. 47.1% of the control group had sometimes postprandial gas problems. In addition, 76.5% of the study group and 52.9% of the control group did not have postprandial bloating.

DISCUSSION

WHO defined probiotics as "live microorganisms, which when consumed in adequate amounts confer health and benefit to the host". Probiotics are most commonly consumed worldwide in the form of yoghurt or other fermented dairy products and they are administered in many different forms including various dietary supplements.[22] The current research aimed to study the effect of a weight-loss diet, exercise program and oral probiotic supplement on BMI and gastrointestinal problems such as postprandial gas, bloating and indigestion in women. We found that diet and exercise were effective in weight loss in both groups and the use of probiotics can relieve postprandial gas problems. Jung *et al.*, investigated the effects of supplementation of the association of two probiotics, Lactobacillus curvatus HY7601 and Lactobacillus plantarum KY1032 in body adiposity in overweight subjects. After 12 weeks of intervention, the probiotic group had a significant reduction in body mass compared to the beginning of treatment.[23] However, Zarrati *et al.*, investigated the effects of probiotics by ingestion of yoghurt with the combination of Lactobacillus acidophilus LA5, Lactobacillus casei DN001 and Bifidobacterium lactis BB12 for 8 weeks. They found reduced body mass after 8 weeks in the probiotic groups with diet and the group with diet without probiotics. Therefore, no additional effect of probiotics was observed for weight loss.[24] In our study, we found a significant decrease in the body weights of both the study and control groups in the fourth and eighth weeks of the study. No additional effect of probiotics was observed. Therefore, we can infer that an exercise and diet program induces weight loss in overweight and obese individuals. Kalman *et al.*, conducted a randomized, placebo-controlled clinical trial that compared a probiotic dietary supplement's effects on gastrointestinal symptoms in sixty-one adults who were between 20-68 years of age with postprandial intestinal gas-related symptoms. They found that the Bacillus coagulans-based probiotic dietary supplement was effective in reducing gastrointestinal symptoms in adults with postprandial intestinal gas-related symptoms.[25] In 2021, Schreiber *et al*. examined the effect of probiotic supplementation on performance and gastrointestinal symptoms like heartburn, belching and vomiting in twenty-seven male elite road cyclists 19 to 40 years old age. They observed a significant decrease in the occurrence of gastrointestinal symptoms at rest and during training.[26] Le Nevé *et al.*, investigated a fermented milk product containing B. lactis CNCM I-2494 and lactic acid bacteria that may reduce subjective and objective components of flatulence in 63 healthy subjects (both genders; 18–75 years age range) challenged by a diet rich in fermentable residues. Their results showed that B. lactis CNCM I-2494 and lactic acid bacteria improved the sensitivity of subjects' intestines to a flatulogenic diet and the number of anal gas evacuations.[27] Consistent with these researches, in our study, the study group had no constipation problems in the fourth and eighth weeks of the study. These results indicated that the constipation problem was

Table 4. Constipation status and incidence of constipation at the end of 8 weeks.

		Experimental		Control		Total		*p*
		n	%	n	%	n	%	
Constipation problem	Yes	0	0.0	1	5.9	1	2.9	0.231
	No	10	58.8	6	35.3	16	47.1	
	Sometimes	7	41.2	10	58.8	17	50.0	
Constipation, if yes, how often	Everyday, 5-6 per week	0	0.0	0	0.0	0	0.0	0.152
	1-4 per week	7	38.9	11	61.1	18	100.0	

Chi-square test was used, statistically significant as *$p< 0.05$

Table 5. Bloating, gas and indigestion after eating at the beginning of the study

		Experimental		Control		Total		*p*
		n	%	n	%	n	%	
Gas during the postprandial period	Yes	5	29.4	4	23.5	9	26,5	0.918
	No	4	23.5	4	23.5	8	23.5	
	Sometimes	8	47.1	9	53.0	17	50.0	
Bloating during the postprandial period	Yes	6	35.3	8	47.1	14	41.2	0.579
	No	2	11.8	3	17.6	5	14.7	
	Sometimes	9	52.9	6	35.3	15	44.1	
Indigestion during the postprandial period	Yes	4	23.5	6	35.3	10	29.4	0.674
	No	2	11.8	1	5.9	3	8.8	
	Sometimes	11	64.7	10	58.8	21	61.8	

Chi-square test was used, statistically significant as *$p< 0.05$

Table 6. Bloating, gas and indigestion after eating at 4 weeks of the study

		Experimental		Control		Total		*p*
		n	%	n	%	n	%	
Gas during the postprandial period	Yes	0	0.0	5	29.4	5	14.7	0.016*
	No	12	70.6	7	41.2	19	55.9	
	Sometimes	5	29.4	5	29.4	10	29.4	
Bloating during the postprandial period	Yes	1	5.8	4	23.5	5	14.7	0.320
	No	8	47.1	6	35.3	14	41.2	
	Sometimes	8	47.1	7	41.2	15	44.1	
Indigestion during the postprandial period	Yes	1	5.9	4	23.5	5	14.7	0.141
	No	10	58.8	5	29.4	15	44.1	
	Sometimes	6	35.3	8	47.1	14	41.2	

Chi-square test was used, statistically significant as *$p< 0.05$

Table 7. Bloating, gas, and indigestion after eating at the end of 8 weeks.

		Experimental		Control		Total		*p*
		n	%	n	%	n	%	
Gas during the postprandial period	Yes	0	0.0	1	5.8	1	2.9	0.067
	No	14	82.4	8	47.1	22	64.7	
	Sometimes	3	17.6	8	47.1	11	32.4	
Bloating during the postprandial period	Yes	0	0.0	2	11.8	2	5.9	0.142
	No	13	76.5	9	52.9	22	64.7	
	Sometimes	4	23.5	6	35.3	10	29.4	
Indigestion during the postprandial period	Yes	0	0.0	3	17.6	3	8.8	0.082
	No	13	76.5	9	53.0	22	64.7	
	Sometimes	4	23.5	5	29.4	9	26.5	

Chi-square test was used, statistically significant as *$p< 0.05$

improved with the use of probiotics. In addition to this, in the fourth week of the study, it was observed that there was a difference between the groups in terms of postprandial gas problems. Also, the experimental group had no postprandial bloating and indigestion problems at the end of the study.

Some limitations should be taken into account in interpreting our results. Gut flora changes were not analyzed, limiting our understanding of the direct supplementation effects on gut flora. The relatively small sample size, besides socio-cultural factors among the women, was not considered in both groups.

CONCLUSION

It was concluded that the diet and exercise given to both groups were effective in weight loss and the use of probiotics positively affected the gastrointestinal system. Since the effects of probiotics on constipation, gas problems, bloating and digestion are shown by the studies, to better understand the probiotic effects on the weight loss process and gastrointestinal system problems, randomized controlled studies including healthy individuals should be conducted to support these findings. In addition, long-term monitoring of the participants participating in such studies will provide more effective results in future studies.

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Author Contribution (Authors initials)

Research idea: SB, design of the study: YOİ, Acquisition of data for the study: YOİ, analysis of data for the study: MB, Interpretation of data for the study: MB, drafting the manuscript: SB, revising it critically for important intellectual content: Final approval of the version to be published: SB.

*The authors declare that there are no conflicts of interest.

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