

Sabine Hazan, MD, Series Editor

## How Globalization Changes the Microbiome



Skylar Steinberg



Sabine Hazan

**G**lobalization, which is the fusing of disparate trade agreements, communications, economies, technologies, and cultures,<sup>1</sup> has significantly changed humans' environments, diets, and overall health. The term "globesity" refers to the shift from traditional, localized diets to a Western diet, known as "nutrition transition."<sup>2</sup> Research has shown that increasing globalization by one standard deviation often results in a 23.8% increase in obesity and a 4.3% rise in calorie intake.<sup>3</sup> Integrating Western habits alters lifestyles, demographics, and economic conditions in ways that promote obesogenic environments. Global trade agreements facilitate the consumption of highly-processed foods in lieu of traditional fare, such as fruits, vegetables, and raw foods. As a result, communities across the world are eating more high-fat, high-sugar foods, as well as larger quantities of meat than before.<sup>4</sup>

Historically, the digestive tract's microbial ecosystem was tailored for a specific geographic area, much as the flora and fauna of an ecosystem are geographically distinct.<sup>5</sup> However, the rise of

globalization has spurred a mass transition of the European and American microbiome worldwide, altering the unique digestive patterns and processes of other nations, which has, arguably, caused a global rise in obesity.<sup>6</sup> For example, Western microbiomes consist of 15% to 30% fewer species than non-Western microbiomes<sup>7</sup> and research shows that lower gut microbiome diversity is associated with weight gain.<sup>8</sup> Therefore, it is fair to partially attribute our global obesity epidemic to the decrease in microbial diversity because of a larger adaptation of a Western diet.

The "disappearing microbiome hypothesis" has been used to describe how technological and cultural changes accompanying industrialization has led to a "disappearing microbiome".<sup>9</sup> Bacteria in the genus *Treponema*, which appears in the stool of numerous non-Western populations, for example, does not appear in the microbiomes of those in Western civilizations.<sup>10</sup>

Additionally, Western microbiomes generally bear a greater amount of *Bacteroides*, while non-Western microbiomes generally contain greater amounts of Firmicutes and Proteobacteria,<sup>11</sup> and the ratio of these phyla has been associated with the development of obesity.<sup>12</sup>

After the age of three, the adult microbiome develops and becomes highly-resistant to changes

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Skylar Steinberg, BS, Health Promotion and Disease Prevention, Research Assistant, Ventura Clinical Trials Sabine Hazan, MD, Gastroenterology/Hepatology/Internal Medicine Physician, CEO, Ventura Clinical Trials, CEO, Malibu Specialty Center, Ventura, CA

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on a short-term basis. However, long-term dietary shifts can result in significant impacts and can potentially harm future generations. As we age and our health deteriorates, the stability and diversity of the gut microbiota declines, which major changes to diet can exacerbate and accelerate.<sup>13</sup>

Long-term diet studies have shown that humans can alter the ratio of Bacteroidetes and Firmicutes by consistently consuming different foods abnormal to our environments.<sup>14</sup> Additionally, evidence shows that our diet shapes the relative abundance of dominant phyla in our systems and the composition of macronutrients that we consume influence specific bacterial groups.<sup>15</sup>

This Western dietary shift can significantly impact developing nations, which are more susceptible to obesity and other diseases. Low-cost, easily-accessible packaged food also decreases the need for physical activity and as these populations start eating differently, it can significantly harm their gut biome and lead to other health complications.<sup>16</sup>

While more research is needed to better assess how globalization causes the microbiome to shift, it's evident that people in developing areas lack the necessary resources and education to inform them how consuming these processed, high-fat, and high-sugar Westernized foods can compromise their overall health. ■

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Answers to this month's crossword puzzle:

1	M	E	S	E	N	C	H	Y	M	A	L	7	E	K	8	G		
	O		P		O		O		E		I		P		U			
9	T	R	A	C	T			10	M	A	G	N	E	S	I	U	M	
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11	L	U	M	I	N	12	A	L			13	S	I	P	H	O	15	N
	I					16	G	L	O	S	17	S		N		E		O
18	T	E	A	R		20	A	G	E		21	R	E	F	L	U	X	
	Y		N		22	B	U		23	J	A	R		I				I
		24	S	A	L	I	N	E		25	A	N	T		26	A	G	O
27	S		C		O				28	B	U	G		29	A	L		U
30	T	H	I	O	P	U	R	I	N	E	33	S				34	E	S
35	R	E	D		L		36	A	D	D		I		37	U			
38	O	X	I	D	A	N	T			39	I	N	G	E	S	T	40	S
	M		T		S		I		C		N		D		E			
41	A	M	Y		42	M	O	O	S	E	43	S	T	A	G	E		