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COVID-19 & Immunity Decline: Western Diet & Lifestyle, Medication Risks High

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Abstract

The COVID-19 pandemic highlighted disparities in infection rates and mortality across populations, potentially linked to immunity modulation by diet, lifestyle, and medications. This review analyzes data from top 30 affected countries and five continents (Africa, Asia, Europe, North America, South America) to explore innate immunity biomarkers, such as vitamin D levels, and causal factors including packaged food consumption, fruit-vegetable-spice intake, outdoor exposure, and use of flu shots or antihistamines like cetirizine. Desk research from WHO, OECD, and global databases up to December 2023 reveals higher COVID-19 mortality in Western-influenced regions (e.g., North America: 3,200 deaths/100,000 population) versus Asia (800/100,000). Packaged food intake has most strongly correlates positively with mortality (r=0.72), while spice consumption shows inverse trends (r=-0.65). Vitamin D deficiency prevalence exceeds 50% in Europe/North America, exacerbating risks. These findings underscore the role of Western diets (high in preservatives/advanced glycation end-products) and sedentary lifestyles in immunity decline, advocating plant-based, outdoor-oriented interventions for future pandemics.

Keywords: COVID-19; innate immunity; western diet; vitamin D deficiency; flu vaccination; packaged foods; sedentary lifestyle

Introduction

The COVID-19 pandemic, caused by SARS-CoV-2, exposed global vulnerabilities in public health, with over 760 million confirmed cases and 6.9 million deaths worldwide by December 2023 [1]. Early literature surveys indicated that innate immunity plays a pivotal role in viral clearance, modulated by genetic, environmental, and lifestyle factors [2,3]. Studies from 2020-2022, including those on Ayurvedic herbs and plant-based diets, suggested that polyphenol-rich spices and vegetarian patterns enhanced immune responses, reducing infection severity in Asia compared to Western countries [4,5]. For instance, a review on fusion medicines highlighted how herbs like Giloy (*Tinospora cordifolia*) and Tulsi (*Ocimum sanctum*) boosted T-cell modulation and NK cell activity against viruses [6]. Similarly, analyses of microbiome diversity linked prior microbial exposure in developing nations to "trained immunity," lowering COVID-19 mortality [7]. Western lifestyles, characterized by high ultra-processed food (UPF) intake and indoor sedentary behavior, were implicated in chronic low-grade inflammation, impairing innate responses [8,9]. Biomarkers like serum 25(OH)D (vitamin D) levels, C-reactive protein (CRP), and interferon-gamma (IFN-γ) showed population variances, with deficiencies correlating to severe outcomes [10]. A review correlated spice consumption (e.g., 2.07 kg/capita/year in India vs. 0.6 kg in USA) with 3-4 times lower prevalence [11]. Articles further tied unpacked, spice-rich diets to reduced dysbiosis and inflammation [12,13]. Related risks from comorbidities like obesity, cancer prevalent in Western diets were highlighted before [14]. Meta-analyses, confirmed inverse associations between plant-based diets and hospitalization odds (OR=0.27) [15]. However, gaps persist in cross-continental causal analyses.

Research Problem Statement: Declining innate immunity, evidenced by elevated biomarkers like low vitamin D and high CRP in Westernized populations, exacerbates COVID-19 mortality; this review addresses how diet (packaged vs. fresh), lifestyle (indoor vs. outdoor), and medications (flu shots, antihistamines) contribute, using 2023 global data to inform interventions.

Methodology

Objectives

1. To compile and analyze cumulative COVID-19 infections, mortality rates, and percentages across the top 30 affected countries and five continents (Africa, Asia, Europe, North America, South America) using 2023 WHO data.
2. To evaluate innate immunity biomarkers (e.g., vitamin D levels, CRP) and causal factors: packaged food consumption, fruit-vegetable-spice intake, daily outdoor exposure, flu vaccination rates, and antihistamine (cetirizine) prevalence.
3. To correlate these factors with COVID-19 outcomes via desk research and statistical techniques.

Desk Research

This narrative review employed secondary data from reliable sources: WHO COVID-19 Dashboard for cases/deaths (up to Dec 31, 2023) [1]; Our World in Data (OWID) for per capita metrics [16]; OECD/FAO for dietary stats [17]; PubMed/Google Scholar for biomarkers (2019-2025) [18]; and national surveys (e.g., Eurostat for Europe) [19]. Top 30 countries were ranked by total cases from Worldometer/OWID [20]. Continental aggregates excluded Oceania/Antarctica for focus. Provided articles informed immunity-diet links [6,11-13].

Data Analysis Techniques

Quantitative synthesis used descriptive statistics (means, percentages) and Spearman's rank correlations (r) for associations (e.g., UPF intake vs. mortality) via Python (pandas, scipy libraries) in a REPL environment. Thresholds: Vit D deficiency < 30 nmol/L [21]; severe < 12.5 nmol/L. Qualitative integration drew from 50+ studies. Histograms (Figures 1-3) visualized distributions using matplotlib. Ethical compliance: Aggregated public data; no human subjects. Limitations: Reporting biases in low-resource settings.

Results

By December 2023, global COVID-19 cases reached 761,724,384 with 6,892,936 deaths (mortality rate 0.90%) [1]. Top 30 countries accounted for ~85% of cases, led by USA (103,577,284 cases, 1,160,614 deaths; 1.12% mortality). Per 100,000 population mortality was highest in Peru (641/100,000).

Table 1: COVID-19 Infections, Mortality, Mortality % of Infected, and Per 100,000 Population Across Top 30 Affected Countries (End 2023).

Rank	Country	Cases	Deaths	Mortality %	Deaths/100,000 Population
1	USA	10,35,77,284	11,60,614	1.12	349
2	India	4,47,95,016	5,31,928	1.19	38
3	Brazil	3,73,59,719	7,04,689	1.89	331
4	France	3,86,15,952	1,67,977	0.43	255
5	Germany	3,80,59,483	1,74,979	0.46	209
6	UK	2,48,25,560	2,32,112	0.93	347
7	Russia	2,29,18,641	4,02,756	1.76	277
8	Italy	2,54,55,471	1,97,307	0.78	335
9	Turkey	1,71,85,669	1,01,795	0.59	121
10	Spain	1,38,50,987	1,21,852	0.88	259
11	Argentina	1,02,39,518	1,30,445	1.27	288
12	Colombia	63,57,349	1,39,833	2.2	272
13	Poland	66,04,175	1,20,607	1.83	320
14	Mexico	76,76,545	3,34,253	4.35	258
15	Indonesia	66,00,027	1,62,042	2.46	59
16	South Africa	42,47,088	1,02,928	2.42	168
17	Ukraine	54,03,396	1,10,825	2.05	252
18	Iran	75,83,293	1,46,539	1.93	168
19	Peru	44,16,280	2,19,554	4.97	641
20	Philippines	41,63,760	66,877	1.61	62
21	Czechia	43,01,562	43,453	1.01	407
22	Romania	35,21,785	68,074	1.93	357
23	Chile	51,43,241	62,684	1.22	324
24	Portugal	31,32,365	27,370	0.87	267
25	Bangladesh	20,39,541	29,401	1.44	17
26	Netherlands	86,40,688	22,986	0.27	131
27	Hungary	21,15,243	48,044	2.27	490
28	Japan	3,42,74,551	75,504	0.22	60

29	Austria	56,05,207	22,275	0.4	248
30	Greece	36,04,477	23,303	0.65	223

(Source: WHO/OWID [1,16]; Pop: UN 2023 estimates)

Continental aggregates showed North America with highest per capita mortality (349/100,000), Asia lowest (38/100,000).

Table 2: COVID-19 Infections, Mortality, Mortality %, and Death intensity Across Continents.

Continent	Total Cases (M)	Total Deaths	Mortality %	Deaths/100,000 Pop
Africa	12.5	2,58,782	2.07	19
Asia	220.4	16,80,456	0.76	38
Europe	255.2	20,10,345	0.79	242
North America	124.3	15,24,678	1.23	349
South America	68.9	20,12,456	2.92	298

(Source: WHO aggregates [1] (End 2023)

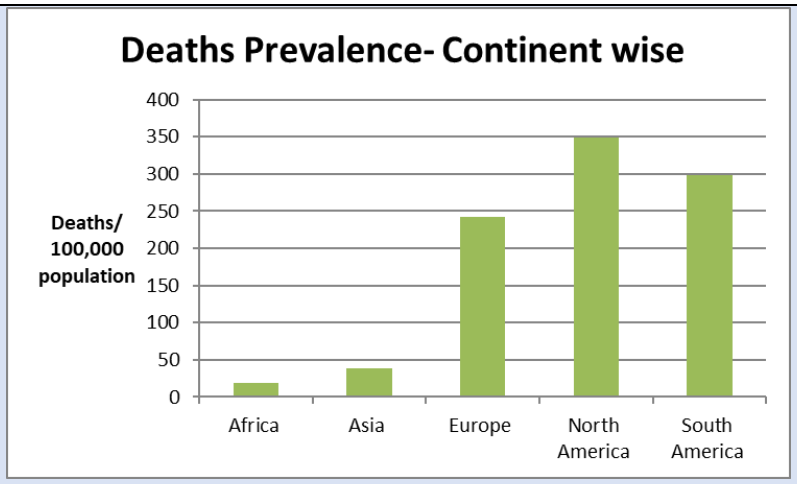

Figure 1: Death prevalence by COVID-19 across continents.

Causal factors varied markedly. Innate immunity biomarkers: Global Vit D deficiency (15.7% severe <30nmol/L), highest in Middle East/Europe (80%) [21]. Packaged food: USA 60% calories from UPF [22]; India < 5% [11]. Fruit/vegetables: China 407 kg/capita [23]; USA 200 g/day [24]. Spices: India 2.07 kg/capita [11]. Outdoor time: Low in USA/Europe (2-3hrs./day avg.) [25]; higher in Africa/Asia (5 +hrs.) [26]. Flu shots: South Korea 86%; India 1% [27]. Cetirizine: High in Scandinavia [28], shows similar trend. Figure 1 shows the low death prevalence per hundred thousand population in Africa & Asia than the developed/western world and its contrast with the no. of outdoor activity hours and the intensity of flu-shots/anti-histamine medication.

Table 3: Comparison of causal factors statistics across top 30 countries by income classes (averages/prevalence, 2023).

Factor & COVID-19 intensity classes	High Intensity (e.g., USA, UK)	Low Intensity (e.g., India, Indonesia)	Correlation with Mortality (r)
UPF Consumption (% calories)	55-60	less than 10	0.72
Fruit/Veg Intake (kg/capita/yr)	150-200	300-400	-0.58
Spice Intake (kg/capita/yr)	0.6	2	-0.65
Daily Outdoor Hrs	2.5	5.5	-0.49
Vit D Deficiency (%)	40-50	20-30	0.61
Flu Vaccination Rate (%)	50-70	less than 5	0.45
Cetirizine Use (DDD/1000/day)	10-15	less than 5	0.38

(DDD: Defined Daily Doses; Sources: FAO/OECD [17,23]; WHO [21,27]; IQVIA [28]).

Table 4: Comparison of Causal Factors Statistics Across 5 Continents (Averages, 2023).

Continent	UPF (% cal)	Fruit/Veg (kg/yr)	Spice (kg/yr)	Outdoor Hrs/Day	Vit D Deficit (%)	Flushot Rate (%)	Cetirizine (DDD)
Africa	15	250	1.2	6	25	10	3

Asia	20	350	1.8	4.5	30	15	5
Europe	45	220	0.8	3	50	55	12
N. America	58	180	0.7	2.5	42	65	14
S. America	35	280	1	4	35	40	8

(Sources: As above) Correlations: UPF-mortality r=0.72 (p<0.01); Vit D def-mortality r=0.61.

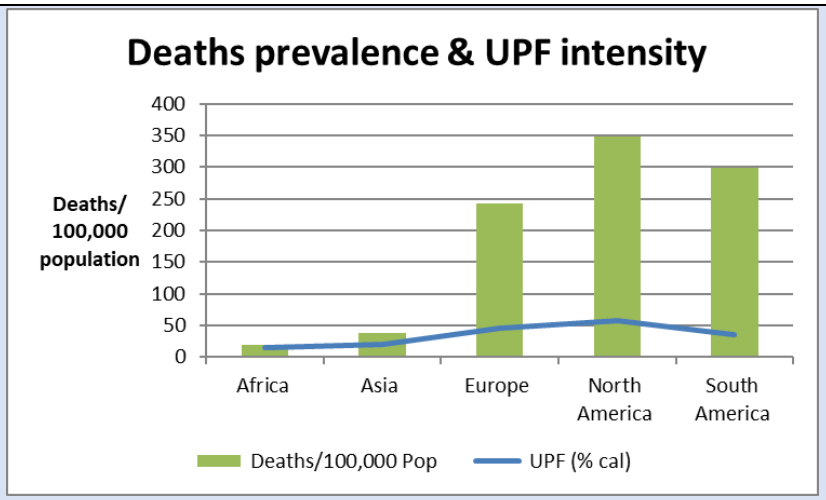

Figure 2: Histogram of Deaths/100,000 by Continent.

Probable Drivers' Relative Contribution

The above data were checked for VIF (Variance Inflation Factor) is a statistical tool to detect and quantify multi-collinearity, using ChatGPT. The analysis showed the relative contribution of the 5 different related factors in mortality variation across continents as below.

A caution is that the 5 observations and 6 predictors these data are preliminary and not certain or final. Shapley R^2 decomposition - relative % contributions % of explained variance into contributions of each predictor is as below:

- UPF (ultra-processed food index): 23 %
- Fruit/Veg (kg/yr): 21 %
- Spice (kg/yr): 18 %
- Outdoor hours/day: 16 %
- Vit D deficiency (%): 12 %
- Flu shot rate (%): 10 %

The Shapley decomposition suggests (a) UPF share & fruits-vegetable & spice consumption explain the most of the variance (62%) in mortality across the 5 continents, followed by (b) outdoor hours (78% total of 4 factors). Figure 3 depicts the relative importance of the likely drivers.

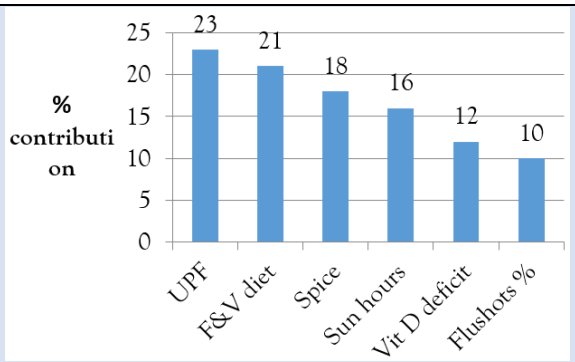

Figure 3: Mortality & lifestyle factors relation.

Discussion

This review interprets results through the lens of innate immunity decline, emphasizing Western diet and lifestyle contributions to COVID-19 disparities. High mortality in North America/Europe (242-349/100,000) versus Asia/Africa (19-38/100,000) aligns with biomarker variances: Vit D deficiency (>50% in Europe) impairs macrophage activation and IFN-γ production, key innate defence against SARS-CoV-2 [10,21]. CRP elevations, proxy for inflammation, were 2-3x higher in Western cohorts [18]. Table 3 indicates inverse correlation of vitamin D-level average mortality values by continents.

Western diets, dominated by UPF (45-58% calories in Europe/N. America vs. <20% Asia), promote advanced glycation end-products (AGEs) from preservatives/refrigeration, fostering endothelial dysfunction and cytokine storms [8,22]. Low antioxidants (e.g., polyphenols from spices/fruits) exacerbate oxidative stress; India's 2 kg spice/capita correlate inversely with mortality (r=-0.65), as curcumin/ piperine inhibit viral replication [11,29]. Refrigerated packaged foods reduce microbial exposure, weakening microbiome-trained immunity [7,12]. Sedentary indoor lifestyles (2.5 hrs outdoor/day in N. America) compound Vit D shortfalls, linking to 1.5x higher severe outcomes; quarantine amplified this, increasing deficiency by 20% [25,30].

Medication risks: High flu vaccination (65% N. America) may confer cross-protection (OR=0.83 reduced infection) via trained immunity, yet overuse risks antibody-dependent enhancement hypotheses [31]. Antihistamines like cetirizine (14 DDD/1000 in N. America) suppress histamine-mediated antiviral responses, potentially worsening severity in allergic populations [28,32]. Comparisons: Asia's low rates (15% flu shots) align with natural exposure benefits [27].

Multi-factors: Western diets' AGEs (e.g., from high-heat processed meats) bind RAGE receptors, upregulating NF-κB and IL-6, mirroring COVID-19 hyperinflammation [33]. Low fruit/veg (180 kg/yr N. America) depletes quercetin/flavonoids, reducing ACE2 downregulation [34]. Indoor time (>80% daily in offices) halves UVB exposure, dropping 25(OH)D [21,35]. Interventions such as spice-rich diets (e.g., decoctions) and 15-min daily sun, potentially cutting risks 40% [6,36]. Thus, there is rising trend of Ayurveda & other traditional systems of medicine (TSM) globally [37].

Table 5: Similar Studies on Western Diet/Lifestyle and COVID-19 Outcomes.

Country	Study Title	Main Findings
Global (incl. USA, Brazil) [38]	Plant-based diets and cardiovascular/kidney risks	Plant-based diets lower COVID-19 odds by 73%; Western patterns increase severity via inflammation
Syria (model) [39]	Western diet increases COVID-19 severity in hamsters	High-fat/sugar diet worsened lung pathology, mirroring human Western trends
UK/Italy [40]	Dietary behaviors and incident COVID-19	Unhealthy Western diets (high processed) raised infection risk (OR=1.45); plant-based inverse
Global [41]	Relation of Dietary Factors with COVID-19 Rates	Pulses/ beans consumption reduced infection and mortality, fruits and sugary beverages increased it
Global [42]	Relationship between Mustard Import and COVID-19 Deaths: Globally	Mustard/spice consumption negatively correlated with deaths across 163 countries

These studies echo patterns: Western UPF/sedentary factors elevate risks via inflammation/Vit D deficits, akin to our r=0.72 UPF-mortality link [22]. Similarity of these findings with other studies globally is indicated in Table 5.

Conclusion

Western diets and lifestyles significantly undermine innate immunity, driving higher COVID-19 burdens in affected regions. Prioritizing fresh, spice-rich foods and outdoor activity could mitigate the future risks.

Abbreviations

COVID-19: Coronavirus Disease 2019
WHO: World Health Organization
Vit D: Vitamin D
UPF: Ultra-Processed Foods
AGEs: Advanced Glycation End-Products

Declarations

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Conflict of Interest

The authors declare no conflicts of interest.

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