REVIEW PAPER

A Scoping Review on Institutionalization of Packaged Food Consumption in Academic Settings and Its Role in Promoting Diabetes Risk

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Abstract

Background: The global burden of type 2 diabetes mellitus (T2DM) is escalating at an unprecedented rate, with 536.6 million adults affected worldwide as of 2021, a figure projected to rise to 783 million by 2045. India alone harbours over 77 million adults with diabetes, the second-largest absolute burden globally. Ultra-processed foods (UPFs), classified under the NOVA food system, have emerged as a robust, dose-dependent dietary risk factor for T2DM. Despite this evidence, academic institutions including medical colleges and teaching hospitals remain an overlooked micro-environment where packaged UPF consumption is normalised through routine distribution at seminars, conferences, and grand rounds. This is particularly paradoxical in health-sector institutions whose mandate is chronic disease prevention. **Objective :** To compile data associating the intake of ultra-processed foods to the risk of type 2 diabetes, investigate the impact of academic institutional food environments on dietary habits, and determine evidence-based approaches for institutional food environment reform in the Indian setting. **Material & Methods:** This scoping review was conducted in accordance with the PRISMA Extension for Scoping Reviews (PRISMA-ScR) guidelines (Tricco et al., 2018; Ann Intern Med). A systematic search was performed across PubMed/MEDLINE, Scopus, Web of Science, and Google Scholar for studies published January 2000 to March 2025. The research question was framed using the Population-Concept-Context (PCC) framework. Two independent reviewers screened records and extracted data using a structured charting form. Thematic synthesis addressed five domains: UPF epidemiology, pathophysiological mechanisms, institutional food environments, India-specific evidence, and policy recommendations. **Results:** A total of 1,412 records were identified; 68 studies met full eligibility. Evidence consistently demonstrates a hazard ratio of 1.24 (95% CI 1.14-1.34) for the highest versus lowest UPF consumption category, and a 13% increased T2DM risk per 10% increment in UPF dietary share (HR 1.13, 95% CI 1.08-1.18). Five mechanistic pathways were delineated: nutritional degradation, diabetogenic food additives, processing-derived toxic compounds, packaging-derived endocrine disruptors, and gut microbiome dysbiosis. In India, UPF retail sales grew at 13% compound annual growth rate from 2011-2021, with biscuits accounting for over 43% of market share, the category most widely distributed at Indian academic events. A critical evidence gap exists as no validated intervention studies examine institutional food environment reform in Indian academic settings. **Conclusion:** Academic institutions, particularly health-sector colleges, may benefit from transitioning from convenience-driven food provision toward evidence-informed health-promoting food environments. Ongoing FSSAI front-of-pack labelling deliberations may influence future procurement practices. Institutional food policy reform, integration with the National Programme for Non-Communicable Diseases, and primary research in South Asian academic settings remain important priorities.

Keywords: ultra-processed foods; type 2 diabetes mellitus; institutional food environment; academic settings; NOVA classification; India; NCD prevention; food policy; scoping review

Introduction

1.1 Global and National Burden of Type 2 Diabetes

Diabetes mellitus is the defining metabolic epidemic of the twenty-first century. The International Diabetes Federation (IDF) Atlas, reported that 536.6 million adults aged 20-79 years which represent 10.5% of the world's adult population, were living with diabetes in 2021. [1] This figure is projected to rise to 783.2 million (12.2%) by 2045, a 46% absolute increase driven primarily by urbanisation, population ageing, and dietary transition. [1] Global diabetes-related health expenditures already exceed USD 966 billion annually and are projected to surpass USD 1 trillion by 2045. [1]

India occupies a particularly critical position in the global diabetes landscape. With an estimated 77 million adults with diabetes in 2021, the second-largest absolute burden after China, India's age-adjusted prevalence of 9.6% is projected to reach 10.9% by 2045. [2] The social and economic costs are equally stark: the Indian Council of Medical Research's landmark Global Burden of Diseases (GBD) India report documented that diets low in fruits, vegetables, and whole grains but high in salt, sugar, and fat are among the leading contributors to NCD-related mortality in India. [3] Non-communicable diseases, predominantly cardiovascular disease and diabetes, now account for over 60% of all deaths in India. [3]

Over 95% of the global diabetes burden is attributable to type 2 diabetes mellitus (T2DM), a condition whose trajectory is fundamentally driven by modifiable behavioural risk factors. Among these, the consumption of ultra-processed foods (UPFs) has emerged as a nutritional risk factor of considerable independent significance as its pathological influence extends well beyond conventional nutrient-based frameworks.

1.2 The Ultra-Processed Food Phenomenon: NOVA Classification and Indian Context

Ultra-processed foods (UPFs) are formally defined as within the NOVA food classification system, which groups all edible substances into four categories according to the nature, extent, and purpose of their industrial processing: Group 1 (unprocessed or minimally processed foods), Group 2 (processed culinary ingredients), Group 3 (processed foods), and Group 4 (ultra-processed foods). [4] Group 4 or UPFs are industrial formulations manufactured predominantly from food-derived substances, chemical modifications of those substances, and cosmetic additives (including emulsifiers, flavour enhancers, artificial sweeteners, colorants, and anti-caking agents), with little or no intact whole-food content. [4, 5]

In India, the UPF market has expanded at an extraordinary rate. Retail sales of UPFs grew at a compound annual growth rate of 13% between 2011 and 2021, according to a WHO India report. [6] Sweet biscuits alone accounted for over 43% of the UPF market share in 2021 - a product category that is simultaneously the single most commonly distributed refreshment item at Indian academic events. [6] A 2022 study using the National Sample Survey Office consumer expenditure data documented that an average Indian household now derives more calories from processed food products than from fruits. [7] Urban middle-class dietary pattern analyses in India show that biscuits, carbonated beverages, instant noodles, packaged namkeen, and ready-to-eat snacks are now deeply embedded in everyday consumption , driven by urbanisation, rising incomes, aggressive marketing, and, critically, workplace and institutional normalisation. [8]

The South Asia Biobank, which enrolled 63,914 participants across Bangladesh, Pakistan, Sri Lanka, and North and South India between 2020 and 2022, found that approximately 75% of North Indian participants reported consuming UPFs in the preceding 24 hours, with biscuits identified as the single most common UPF source across South Asian regions. [9] This granular data reinforces the ecological relevance of biscuits and packaged snacks, the precise foods distributed at Indian academic gatherings, as the dominant vehicle of UPF exposure in the Indian institutional context.

1.3 Academic Institutions as Unrecognised Dietary Risk Environments

While upstream drivers of UPF consumption such as retail expansion and socioeconomic transition have received sustained academic attention [3,6,7,8], the role of institutional micro-environments has been examined largely in school and workplace settings, while academic health-sector institutions like medical colleges, teaching hospitals, and schools of public health remain comparatively overlooked. Such institutions may themselves shape dietary behaviour through the foods they procure, provide, and endorse at institutional events. The routine provision of packaged biscuits, namkeen, cream rolls, and sweetened beverages all classifiable as ultra-processed under the NOVA framework[4,5], at departmental meetings, CME programmes, and academic conferences may constitute a form of institutional dietary conditioning. This may be particularly relevant in health-sector settings, where a discordance can exist between the preventive health messaging these institutions advocate and the food practices they routinely enact.

1.4 Objectives of This Scoping Review

This scoping review, conducted in accordance with the PRISMA-ScR guidelines, aims to: (1) systematically map the epidemiological evidence linking UPF consumption to T2DM incidence and complications; (2) synthesise the mechanistic pathways through which UPFs promote insulin resistance and diabetes pathogenesis; (3) characterise evidence on academic institutional food environments as determinants of dietary behaviour; (4) examine India- and South Asia-specific evidence on UPF consumption and institutional dietary norms; and (5) identify evidence-based strategies for institutional food environment reform relevant to the Indian context. The review does not aim to conduct quantitative pooling of effect sizes, but rather to map, chart, and identify gaps in the current evidence landscape.

Material & Methods :

This scoping review was conducted during the months of January 2026 to March 2026 following the five-stage methodological framework[11] and reported in accordance with the PRISMA Extension for Scoping Reviews (PRISMA-ScR) checklist [12].

2.1 Research Question (PCC Framework)

(P) Population: Adults (≥18 years) in academic, health-professional training, and health institutional settings, with particular consideration of India and South Asia. **(C) Concept:** Ultra-processed food consumption, its association with T2DM risk and pathophysiology, and the role of institutional food environments in shaping dietary behaviour. **(C) Context:** Academic institutions (including medical colleges, universities, teaching hospitals, and public health training institutions) globally and in low- and middle-income country (LMIC) settings, with particular attention to the Indian regulatory and food systems context.

2.2 Eligibility Criteria

Inclusion: Peer-reviewed studies published between January 2000 to March 2025; in English; examining UPF consumption (NOVA Group 4 or operationally equivalent definitions) in relation to T2DM incidence, complications, or biomarkers of insulin resistance; studies assessing dietary behaviour in institutional settings; systematic reviews, meta-analyses, prospective cohort studies, cross-sectional studies, qualitative studies, and controlled feeding trials.

Exclusion: Case reports; editorials without primary data; non-English publications without validated translations; studies restricted exclusively to paediatric (under 18 years) populations; animal studies not supporting human mechanistic inferences; studies not available in full text.

2.3 Search Strategy

Systematic searches were conducted in PubMed/MEDLINE, Scopus, Web of Science, and Google Scholar. The search string combined three conceptual domains using Boolean operators: ("ultra-processed food" OR "highly processed food" OR "NOVA classification" OR "NOVA Group 4") AND ("type 2 diabetes" OR "T2DM" OR "insulin resistance" OR "glycaemia" OR "HbA1c" OR "diabetes mellitus") AND ("food environment" OR "institutional food" OR "academic setting" OR "university food" OR "medical college" OR "campus food" OR "workplace diet"). MeSH terms were applied in PubMed. Reference lists of included reviews were hand-searched (backward citation). The IDF Diabetes Atlas, WHO NCD reports, and FSSAI regulatory documents were reviewed as grey literature.

2.4 Study Selection and Data Charting

Records were imported to Microsoft Excel for organization and de-deuplication. Two reviewers independently screened titles, abstracts, and full texts using predefined eligibility criteria. Disagreements were resolved through discussion and consensus. As this was a scoping review intended to map available evidence, formal risk-of-bias assessment was not undertaken.Findings were thematically synthesised across five domains. A PRISMA-ScR flow diagram summarises the selection process.

A total of 1,412 records were identified across databases: PubMed (n=524), Scopus (n=388), Web of Science (n=263), and Google Scholar (n=237). After deduplication, 1,038 records were screened. 823 were excluded at abstract level. 215 full texts were assessed; 147 were excluded (principally for not using a NOVA-based UPF definition or lacking diabetic outcome data). Sixty-eight studies met all eligibility criteria and were included in the final synthesis.

Results

3.1 Overview of Included Studies

The 68 included studies comprised: systematic reviews and meta-analyses (n=19), prospective cohort studies (n=24), cross-sectional studies (n=12), randomised controlled or controlled feeding trials (n=5), and qualitative or mixed-methods studies of food environments (n=8). Geographically, studies originated from Europe (n=26), North America (n=18), South America (n=10), Asia including India and South Asia (n=9), and multi-country or globally representative analyses (n=5). A summary of the most evidentially significant included studies is presented in Table 2.

Table 1. Summary of Key Included Studies

Study	Design	Population	UPF Exposure	Outcome	Key Finding
Chen et al., 2023 [13]	3 cohorts + meta-analysis	289,000+ US adults	NOVA 4 % diet weight	Incident T2DM	UPF associated with higher T2DM risk; nutrient mediation <30%
Ayoub-Charette et al., 2025 [14]	SR & meta - analysis	692,508 adults, 14 cohorts	NOVA 4 % diet	Incident diabetes + complications	HR 1.24 (1.14 – 1.34); +10% UPF → 12% more T2DM risk
Moradi et al., 2021 [15]	Dose-response meta-analysis	230,526 adults, 5 studies	UPF servings/day	Incident T2DM	Dose-response confirmed; independent of nutrient quality
Srour et al., 2020 [16]	Prospective cohort	104,707 (NutriNet - Santé)	NOVA 4 by food records	Incident T2DM	Significant T2DM risk after full multivariable adjustment
Kim & Cho, 2024 [17]	Dose-response meta-analysis	International multi-cohort	NOVA 4 servings/day	T2DM risk	Linear dose-response; 12% increased risk per 10% UPF
Lv et al., 2024 [18]	Umbrella review	Multiple meta - analyses	UPF dietary share	T2DM + metabolic disease	Credible, robust evidence across metabolic outcomes
South Asia Biobank, 2025 [9]	Population cohort	60,714 South Asian adults	24-hr UPF recall (NOVA)	UPF patterns	~75% North Indians consumed UPFs; biscuits most common source
Li et al., 2022 [19]	Systematic review	University students globally	Campus food availability	Dietary behaviour	Institutional availability independently predicts UPF consumption
Niles et al., 2021 [20]	Scoping review	Postsecondary institutions	Campus food interventions	Diet quality	Well-positioned for change; most campuses lack healthy food policy

. SR = Systematic Review; NHS = Nurses' Health Study; HPFS = Health Professionals' Follow-up Study.

3.2 Epidemiological Evidence: UPF Consumption and Type 2 Diabetes Risk

3.2.1 Quantitative Risk Estimates

The most recent and comprehensive evidence synthesis demonstrated that the highest category of UPF consumption was associated with a hazard ratio of 1.24 (95% CI 1.14-1.34) for incident diabetes compared to the lowest consumption category, with moderate heterogeneity (I^2=69%) [14]. In a dose-response sub-analysis drawing on four cohort studies, each 10% increment in total dietary UPF contribution was independently associated with a 13% higher risk of T2DM (HR 1.13, 95% CI 1.08-1.18, I^2=37%) [15]. Crucially, this meta-analysis also reported preliminary data from four cohort studies suggesting that among people already diagnosed with T2DM, high UPF consumption is associated with elevated risk of microvascular and cardiovascular complications, chronic kidney disease, and all-cause mortality, extending the diabetogenic consequences of UPFs beyond primary incidence to disease progression and premature death [14].

These findings are corroborated by the landmark French NutriNet-Santé prospective cohort study which found a statistically significant and independent association between UPF consumption and T2DM risk after comprehensive adjustment for more than 20 sociodemographic, lifestyle, anthropometric, and dietary quality covariates. [16] Another analysis of three large US prospective cohorts in Diabetes Care, the Nurses' Health Study, NHSII, and the Health Professionals' Follow-up Study confirmed high-qualityevidence and demonstrated that traditional nutritional mediators (sugar, refined starch, sodium, trans-fat) accounted for fewer than 30% of the total UPF-T2DM association, implicating non-nutritional pathways as quantitatively dominant. [13]

Another dose-response meta-analysis encompassing 230,526 adults from four countries, established the gradient that now forms the quantitative cornerstone of current evidence[15]. This was corroborated by another study in which meta-analysis of prospective studies found a consistent linear dose-response: a 12% higher T2DM risk per 10% increment in UPF dietary contribution[17]. An umbrella review of multiple systematic reviewsfurther confirmed consistent, credible evidence linking UPF consumption to a range of metabolic outcomes including T2DM, central obesity, and metabolic syndrome[18].The UPF-T2DM association attains a degree of consistency and plausibility that is adequate to guide public health action across these convergent, geographically varied, and methodologically rigorous pieces of evidence.

3.2.2 Pre-Diabetes, Glycaemic Dysregulation, and Earlier-Life Exposure

Beyond established T2DM, there is emerging evidence that UPF consumption accelerates the pre-diabetic trajectory. A longitudinal study of young adults (aged 17-22) with a history of overweight or obesity found that increases in UPF dietary share over four years were associated with worsening fasting glucose, rising HbA1c trajectories, and increased incidence of prediabetes, independent of changes in body composition[19,20,21]. The Lifelines cohort further demonstrated that within the heterogeneous UPF category, certain subcategories, including sugar-sweetened beverages, processed meats, and ready-to-eat meals carried disproportionate T2DM risk beyond the aggregate UPF effect, with implications for targeted dietary guidance. [22]

3.3 Pathophysiological Mechanisms Linking UPFs to T2DM

3.3.1 Nutritional Degradation and Metabolic Dysregulation

UPFs are nutritionally characterised by high content of free sugars (principally fructose and sucrose), refined high-glycaemic starches, sodium, and saturated and trans-fatty acids, combined with markedly reduced dietary fibre, micronutrients, and bioactive phytochemicals[4, 15]. These properties converge to promote insulin resistance through multiple overlapping pathways. Excess fructose from UPF-derived added sugar undergoes preferential hepatic uptake, triggering de novo lipogenesis, hepatic steatosis, and impaired insulin receptor signalling a pathway that is amplified by the simultaneously elevated sodium content of UPFs, which activates the aldose reductase-fructokinase pathway in the hypothalamus, further promoting endogenous fructose production and leptin resistance [15]. The fibre paucity of UPFs impairs postprandial glycaemic buffering, reduces short-chain fatty acid production by colonic microbiota (diminishing peripheral insulin sensitivity), and compromises the hormonal gut-pancreas axis. [15]

Notwithstanding these nutritional effects, mediator analysis demonstrate that traditional nutritional factors collectively explain fewer than 30% of the total UPF-T2DM association. [13] This confirms that nutritional quality alone cannot account for the magnitude of UPF-associated T2DM risk, and that non-nutritional mechanisms intrinsic to the industrial formulation and processing of UPFs, rather than their macronutrient content are quantitatively dominant contributors.

3.3.2 Diabetogenic Food Additives

The food additives deployed in UPF formulations carry independent diabetogenic potential that is mechanistically distinct from their nutritional profile. Carrageenan (E407), a sulphated polysaccharide used extensively as a thickener and emulsifier in dairy-alternative products, beverages, and processed deli meats, activates NF-?B-mediated inflammatory pathways and has been shown in experimental and epidemiological research to induce glucose intolerance and impair insulin receptor signalling. A 2024 analysis of 104,139 participants found a significant positive association between dietary carrageenan exposure and incident T2DM even at doses below the established Acceptable Daily Intake, which means direct implications for commonly consumed packaged Indian snack products containing carrageenan-containing coatings or fillings. [23]

Propionate, another preservative widely used in packaged breads, biscuits, breakfast cereals, and sausage casings has been shown to stimulate gluconeogenesis, elevate plasma glucagon concentrations, and increase circulating fatty acid-binding protein 4 (FABP4), all of which promote insulin resistance independently of caloric intake[23]. Artificial sweeteners, including sucralose and aspartame, which are pervasive in 'reduced-sugar' or 'diet' packaged food products, have been associated with altered gut microbiota composition, paradoxical glycaemic dysregulation, and impaired glucagon-like peptide-1 (GLP-1) responses in both experimental and epidemiological studies. [23] High-temperature processing of UPFs generates acrylamide, acrolein, and heterocyclic amines, compounds that induce mitochondrial dysfunction, impair AKT phosphorylation in hepatocytes (disrupting insulin signal transduction), and dysregulate hepatic gluconeogenic gene expression. [23, 24]

3.3.3 Packaging-Derived Endocrine Disruptors

Bisphenol A (BPA), phthalate plasticisers, and per- and polyfluoroalkyl substances (PFAS) which migrate from plastic packaging and food contact materials into UPF products are well-characterised endocrine-disrupting chemicals (EDCs) with documented adverse effects on pancreatic beta-cell function, adipose tissue inflammation, and hepatic insulin sensitivity. [13, 23]. This is of acute relevance to the Indian context, where individually wrapped biscuit packets, plastic-sealed namkeen pouches, and polypropylene-wrapped confectionery distributed at academic events represent direct vectors of packaging-derived EDC exposure.

3.3.4 Gut Microbiome Dysbiosis

Dietary emulsifiers commonly added to UPFs including polysorbate 80 (E433), carboxymethylcellulose (E466), and carrageenan (E407) disrupt the intestinal epithelial mucus layer and alter the composition and diversity of the gut microbiome, reducing the relative abundance of beneficial gut microbiome species. These changes promote increased intestinal permeability, facilitate lipopolysaccharide (LPS) translocation into systemic circulation, and drive low-grade chronic endotoxaemiawhich is a recognised mechanistic driver of peripheral insulin resistance and pancreatic beta-cell inflammatory damage[23]. This demonstrates that microbiome dysbiosis precedes measurable insulin resistance, suggesting that institutional dietary habits during professional training may initiate subclinical diabetogenic processes well before clinical manifestation.

3.3.5 Neurobiological Conditioning and Behavioural Entrenchment

UPFs are deliberately engineered for hyper-palatability through precise combinations of fat, sugar, salt, and umami-enhancing glutamate, which activate dopaminergic mesolimbic reward pathways with an intensity that minimally processed foods do not achieve[19]. This neurobiological conditioning progressively downregulates satiety signalling (through leptin resistance), habituates reward circuitry to UPF-derived stimuli, and diminishes hedonic valuation of whole-food alternatives. Crucially, the behavioural consequences of this conditioning are strongly environment-dependent: institutional exposure to UPFs, particularly during formative professional training years, reinforces and stabilises these neurobiological patterns, making voluntary dietary change substantially more effortful. This provides a biologically grounded explanation for why institutional food environment reform, rather than individual counselling alone, is necessary and sufficient for meaningful population-level dietary change in academic settings.

3.4 Institutional Food Environments and Dietary Behaviour

3.4.1 Evidence from Academic and Campus Settings

A 2022 systematic review, encompassing studies from postsecondary institutions globally, demonstrated that the physical availability, accessibility, and relative affordability of specific food categories within the campus environment are robust predictors of actual consumption patterns, operating independently of individual nutritional knowledge or stated dietary intentions[19]. Studies in this review consistently showed that students who reported greater UPF availability in campus food services consumed significantly larger quantities, irrespective of nutrition education received. Another scoping review identified 46 studies of postsecondary campus food interventions and concluded that tertiary institutions are structurally well-positioned to shift dietary patterns at scale, but that the overwhelming majority of campuses globally have not adopted binding health-oriented food procurement or provision policies. [20]

A systematic review of university food environment assessment methods analysed 36 global studies found that 58% of campus food environment assessments were institution-level audits; across these studies, most institutional food environments were dominated by energy-dense, nutrient-poor options. [25].The analysis found that there is a major lack of validated, standardized assessment techniques for university food environments, which restricts cross-institutional comparability and evidence-based policy creation. This gap is especially severe in LMIC setting. [25]

3.4.2 The Academic Medical Institution Paradox

The institutionalisation of UPF consumption in medical colleges and health-professional training programmes represents the most acute manifestation of the broader problem identified in this review. Multiple included studies document a credibility gap between the dietary guidance disseminated through evidence-based NCD prevention curricula and the food norms enacted through institutional hospitality[10, 20]. A medical student or junior doctor who routinely receives packaged glucose biscuits and sweetened tea as institutional refreshments at departmental meetings, grand rounds, and CME programmes receives a powerful, repeated, experiential message that contradicts the theoretical instruction on dietary risk factors for T2DM. [10]

This contradiction has measurable downstream consequences for professional behaviour. The WHO Health Promoting Hospitals framework and the Health Promoting Universities concept both establish the principle that health-sector institutions should model the healthy behaviours they advocate, encompassing explicitly, food and nutrition environments. [20] The evidence charted in this review suggests that most academic health institutions globally, and virtually Indian medical colleges, fall substantially short of this standard. The critical determinant is structural, not motivational: the problem is not that institutional stakeholders lack knowledge of healthy eating, but that no institutional mechanisms exist to translate that knowledge into procurement decisions, catering briefs, or event hospitality standards.

3.4.3 Structural Barriers to Healthy Institutional Food Provision

A convergent theme across included studies is the identification of structural barriers that perpetuate UPF provision in institutional settings despite stakeholder awareness of the problem. These barriers operate at four levels: (1) Cost : UPFs are typically lower-cost per calorie and per serving than whole-food alternatives, and institutional procurement decisions are disproportionately driven by unit cost; (2) Logistical convenience: individually packaged UPFs require no temperature control, preparation, or skilled handling, making them the default choice for catered events; (3) Behavioural normalisation: repeated institutional exposure conditions both procurement staff and recipients to regard packaged UPFs as normative hospitality offerings, with any deviation perceived as socially unusual; and (4) Regulatory absence : in India and the majority of LMICs, there are no binding standards governing the nutritional quality of foods procured, served, or distributed at institutional academic events, creating a governance vacuum in which the default is UPF provision. [10, 19, 20, 26]

3.5 India-Specific Evidence and the Regulatory Landscape

3.5.1 Dietary Transition and UPF Proliferation in India

India's epidemiological transition is characterised by the simultaneous persistence of undernutrition and the rapid acceleration of diet-related NCDs, the double burden of malnutrition. [3, 7] Adult obesity has more than doubled in a single generation: from 12% to 23% among men and from 15% to 24% among women, according to recent national surveillance data reported in Lancet series on Ultra Processed foods, 2025 [27]. An analysis of India's National Sample Survey Office consumer expenditure data found that the average Indian household's processed food expenditure now exceeds fruit expenditure, a dietary transition occurring at historical speed. [7]

A 2024 BMC Public Health study mapping UPF categories in the Indian food market found that biscuits, carbonated beverages, instant noodles, flavoured wafers, and packaged namkeen are the most frequently purchased and consumed UPF subcategories in India, with biscuits representing the modal UPF product across all socioeconomic strata and urban-rural gradients. [28] Euromonitor International data shows that sales of processed foods in India nearly doubled between 2012 and 2018, from USD 31.30 to USD 57.70 per person annually. [6] This trajectory is driven by urbanisation, increased formal sector employment (with associated institutional food exposure), and the aggressive marketing of packaged snacks targeting professional and student populations.

3.5.2 FSSAI Regulatory Landscape: A Missed Opportunity

The Food Safety and Standards Authority of India (FSSAI) issued draft Front-of-Pack Nutrition Labelling (FoPNL) regulations in September 2022, proposing an 'Indian Nutrition Rating' (INR) system based on the health star rating model[29]. These regulations were intended to provide consumers with a rapid, standardised indicator of nutritional quality for packaged food products, directly relevant to institutional procurement decisions. However, following over public comments and a Committee of Secretaries review in October 2025, FSSAI indicated its intention to withdraw the 2022 draft regulations due to a lack of stakeholder consensus, citing concerns from micro, small, and medium enterprises (MSMEs) about compliance burden and a fundamental lack of agreement on the INR format[29].

Evidence of UPF-related health risks has continuously overtaken regulatory action in India, and the stalling of FSSAI's FoPNL laws is representative of a larger governance issue. When making catering and hospitality procurement decisions, institutional procurement officersincluding those in medical colleges, government hospitals, and universities, lack readily available, standardized tools to distinguish between nutritionally acceptable and high-risk packaged food products due to the lack of required front-of-pack warning labels. This strengthens the argument for sector-specific institutional food recommendations that can be independently operationalized at the institutional level and are independent of national FoPNL implementation.

Discussion

This scoping review identified two related evidence streams. First, higher UPF consumption was consistently associated with increased T2DM risk across multiple cohorts and meta-analyses, with several plausible mechanistic pathways extending beyond nutrient composition. Second, academic institutional food environments appear to be modifiable determinants of dietary behaviour through availability, pricing, accessibility, and social normalisation[1,6, 13, 14, 15, 17, 18,19, 20, 25].

Together, these findings suggest that institutional food practices may represent an underexamined opportunity for diabetes prevention strategies.

4.1 The Medical Institution Paradox

The provision of biscuits, namkeen, and sweetened beverages at national medical college events warrants examination not merely as a question of individual dietary choice, but as a structural public health contradiction with measurable consequences. Medical professionals are the primary agents through which dietary guidance reaches patients with or at risk of T2DM. [2, 9]

If these institutions normalise the very dietary patterns their graduates are trained to counsel against, the cumulative effect on population-level dietary norms and clinical practice is not trivial. Multiple included studies suggest that food environment experience, what one eats in the places where one learns and works exerts a stronger influence on actual dietary behaviour than nutritional knowledge. [19, 25] The implication is that training the next generation of physicians in an environment of institutionalised UPF provision may systematically undermine the capacity of India's health workforce to model, counsel, and advocate for dietary change in their future clinical and public health roles.

Recommendations

The evidence synthesised in this review supports a multi-level, sequentially implementable framework for institutional food environment reform in Indian academic settings.

At the national level, existing NCD prevention frameworks may consider nutritional standards for foods served at publicly funded academic events. At the regulatory level, progress on front-of-pack nutrition labelling may assist evidence-informed procurement. At the institutional level, medical colleges and teaching hospitals could consider healthier default refreshments such as fruits, nuts, and whole-grain options, alongside food environment audits and student awareness initiatives. [3, 19,20,25,26]

Several limitations should be acknowledged. Scoping review methodology does not provide pooled quantitative estimates. Direct evidence from Indian academic institutions remains limited, and some inferences are drawn from broader international food-environment literature. The NOVA classification, while widely used, has recognised limitations in categorising heterogeneous food products.

Critical evidence gaps identified by this review include: (1) primary studies quantifying UPF consumption at Indian academic events and comparing it with whole-food baseline exposures; (2) prospective studies examining whether institutional food environment reform in South Asian settings translates to measurable improvements in biomarkers of insulin resistance among academic community members; (3) cost-effectiveness analyses of healthy institutional food service guidelines in LMIC settings; and (4) qualitative studies examining stakeholder attitudes, structural barriers, and implementation facilitators for institutional dietary reform in Indian medical colleges.

Conclusion

This review suggests that UPF consumption is an important and potentially modifiable risk factor for type 2 diabetes mellitus, while academic institutional food environments may influence dietary behaviour through repeated exposure and social norms. The intersection of these findings indicates that healthier institutional food practices in academic settings could contribute to broader diabetes prevention efforts. Further primary research from Indian institutions is warranted.

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