

NUTRITION AND FILTRATION: THE KIDNEYS EVALUATE EVERY BITE

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Abstract: The effects of fast food, carbonated beverages, caffeine, protein, dehydration, alcohol, and tobacco on kidney function and histological structure were studied. Pathological changes were analyzed in the glomeruli, proximal and distal tubules, interstitial tissue, and renal blood vessels. The findings indicate that improper nutrition and exposure to harmful substances promote degenerative, oxidative, and inflammatory processes in renal filtration tissues, which can contribute to the development of chronic kidney failure over time.

Keywords: Kidney; histology; nephrotoxicity; glomeruli; tubules; interstitial tissue; oxidative stress; chronic kidney disease.

Introduction: Kidney health is critically influenced by lifestyle and environmental factors, including diet, hydration, and exposure to harmful substances such as alcohol, tobacco, caffeine, and high-protein intake. The kidneys perform essential roles in filtration, electrolyte balance, and waste excretion, and their structure is highly sensitive to metabolic and oxidative stress. Improper nutrition and prolonged exposure to nephrotoxic agents can lead to degenerative and inflammatory changes in renal tissues, affecting the glomeruli, tubules, interstitial tissue, and blood vessels. Understanding these histological alterations is essential

for identifying the mechanisms underlying kidney dysfunction and for developing strategies to prevent chronic kidney disease.

Materials and Methods

Kidney tissue samples were examined to assess the effects of fast food, carbonated drinks, caffeine, protein, dehydration, alcohol, and tobacco on renal structure. Two groups were studied: (1) healthy kidneys and (2) kidneys exposed to harmful substances. All samples were fixed in formalin, embedded in paraffin, sectioned, and stained with hematoxylin and eosin (H&E) for light microscopy.

Microscopic evaluation was performed at magnifications of $\times 40$ to $\times 400$, focusing on the glomeruli, proximal and distal tubules, interstitial tissue, and renal blood vessels. Observed pathological changes, including degenerative, oxidative, and inflammatory alterations, were recorded and compared between healthy and exposed tissues to determine the impact of harmful agents on kidney histology.

Results

Microscopic examination of kidney tissues demonstrated significant histological differences between healthy samples and those exposed to harmful substances, including fast food, carbonated drinks, caffeine, protein overload, dehydration, alcohol, and tobacco.

Glomeruli: In healthy kidneys, glomeruli were well-defined, with intact Bowman's capsules, uniform capillary loops, and clearly visible urinary space. In tissues exposed to harmful substances, glomeruli showed degenerative changes, including shrinkage, mesangial expansion, and occasional capillary congestion. Partial collapse of Bowman's space and thickening of the glomerular basement membrane were observed. Some glomeruli exhibited early sclerotic changes, indicating impaired filtration capacity.

Proximal and distal tubules: Healthy tubules displayed a regular arrangement of epithelial cells with intact cytoplasm, prominent nuclei, and clear lumens. The brush borders of proximal tubules were continuous, reflecting normal reabsorptive function. In exposed tissues, tubular epithelial cells were swollen, vacuolated, and occasionally detached from the basement membrane. Lumen shapes were irregular, and cytoplasmic degeneration was evident. Proximal tubules showed partial loss of the brush border, while distal tubules demonstrated thickened epithelial cells and luminal narrowing, suggesting impaired tubular function.

Interstitial tissue: In normal kidneys, interstitial tissue was compact, with evenly distributed connective fibers, capillaries, and no signs of inflammation. Exposed kidneys revealed interstitial edema, infiltration by inflammatory cells, mild fibrosis, and disruption of connective tissue architecture. Capillaries were dilated and congested, and occasional hemorrhagic foci were observed. These changes indicate altered tissue homeostasis and inflammatory activation.

Renal blood vessels: Blood vessels in healthy kidneys had thin walls, intact endothelium, and regular lumen diameter. In kidneys exposed to harmful substances, vessel walls were thickened, endothelial cells were damaged, and hyperemia was present. Some small arteries and arterioles showed early signs of vascular remodeling, including increased perivascular connective tissue and lumen narrowing, which may compromise renal perfusion.

These findings demonstrate that exposure to harmful dietary and lifestyle factors induces a wide range of pathological changes across all renal structures, affecting filtration, tubular reabsorption, interstitial integrity, and vascular function. The observed histological alterations are consistent with degenerative, oxidative, and inflammatory processes and may underlie the functional impairment of the kidneys and increased risk of chronic kidney disease with prolonged exposure.

Conclusion

The study demonstrates that exposure to harmful substances, including fast food, carbonated drinks, caffeine, high protein intake, dehydration, alcohol, and tobacco, causes significant histological alterations in kidney tissues. Degenerative changes were observed in the glomeruli, including shrinkage, mesangial expansion, and partial collapse of Bowman's space. Proximal and distal tubules exhibited epithelial swelling, vacuolization, luminal irregularities, and partial loss of brush borders, indicating impaired reabsorptive function. Interstitial tissue showed edema, inflammatory infiltration, mild fibrosis, and vascular congestion, reflecting disrupted tissue homeostasis. Renal blood vessels displayed wall thickening, endothelial damage, hyperemia, and early signs of vascular remodeling, suggesting compromised perfusion. These structural changes correlate with degenerative, oxidative, and inflammatory processes, providing a morphological basis for impaired kidney function. The findings highlight the potential risk of chronic kidney disease associated with prolonged exposure to dietary and lifestyle-related harmful factors, emphasizing the importance of preventive measures and healthy habits to preserve renal health.

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