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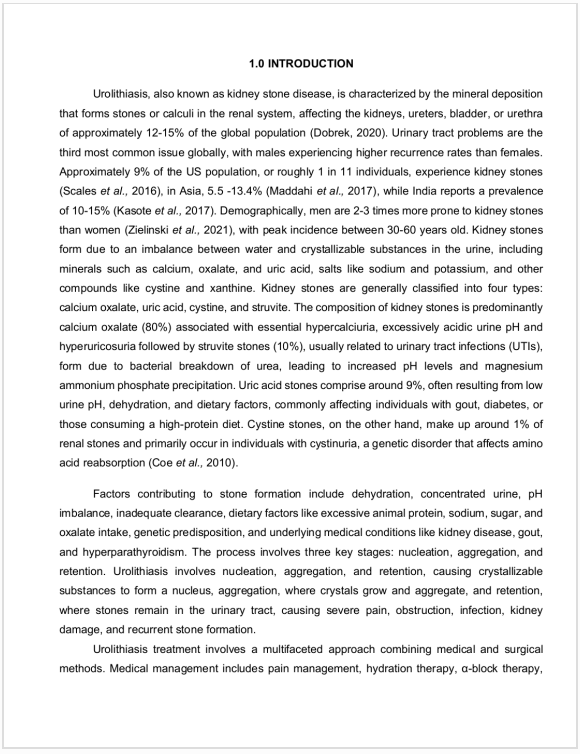

1.0 INTRODUCTION

Urolithiasis, also known as kidney stone disease, is characterized by the mineral deposition that forms stones or calculi in the renal system, affecting the kidneys, ureters, bladder, or urethra of approximately 12-15% of the global population (Dobrek, 2020). Urinary tract problems are the third most common issue globally, with males experiencing higher recurrence rates than females. Approximately 9% of the US population, or roughly 1 in 11 individuals, experience kidney stones (Scales *et al.,* 2016), in Asia, 5.5 -13.4% (Maddahi *et al.,* 2017), while India reports a prevalence of 10-15% (Kasote *et al.,* 2017). Demographically, men are 2-3 times more prone to kidney stones than women (Zielinski *et al.,* 2021), with peak incidence between 30-60 years old. Kidney stones form due to an imbalance between water and crystallizable substances in the urine, including minerals such as calcium, oxalate, and uric acid, salts like sodium and potassium, and other compounds like cystine and xanthine. Kidney stones are generally classified into four types: calcium oxalate, uric acid, cystine, and struvite. The composition of kidney stones is predominantly calcium oxalate (80%) associated with essential hypercalciuria, excessively acidic urine pH and hyperuricosuria followed by struvite stones (10%), usually related to urinary tract infections (UTIs), form due to bacterial breakdown of urea, leading to increased pH levels and magnesium ammonium phosphate precipitation. Uric acid stones comprise around 9%, often resulting from low urine pH, dehydration, and dietary factors, commonly affecting individuals with gout, diabetes, or those consuming a high-protein diet. Cystine stones, on the other hand, make up around 1% of renal stones and primarily occur in individuals with cystinuria, a genetic disorder that affects amino acid reabsorption (Coe *et al.,* 2010).

Factors contributing to stone formation include dehydration, concentrated urine, pH imbalance, inadequate clearance, dietary factors like excessive animal protein, sodium, sugar, and oxalate intake, genetic predisposition, and underlying medical conditions like kidney disease, gout, and hyperparathyroidism. The process involves three key stages: nucleation, aggregation, and retention. Urolithiasis involves nucleation, aggregation, and retention, causing crystallizable substances to form a nucleus, aggregation, where crystals grow and aggregate, and retention, where stones remain in the urinary tract, causing severe pain, obstruction, infection, kidney damage, and recurrent stone formation.

Urolithiasis treatment involves a multifaceted approach combining medical and surgical methods. Medical management includes pain management, hydration therapy, α-block therapy,

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