# Sex Differences in Obesity- and Aging-Mediated Increase of Body Weight and Blood Pressure

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## Introduction

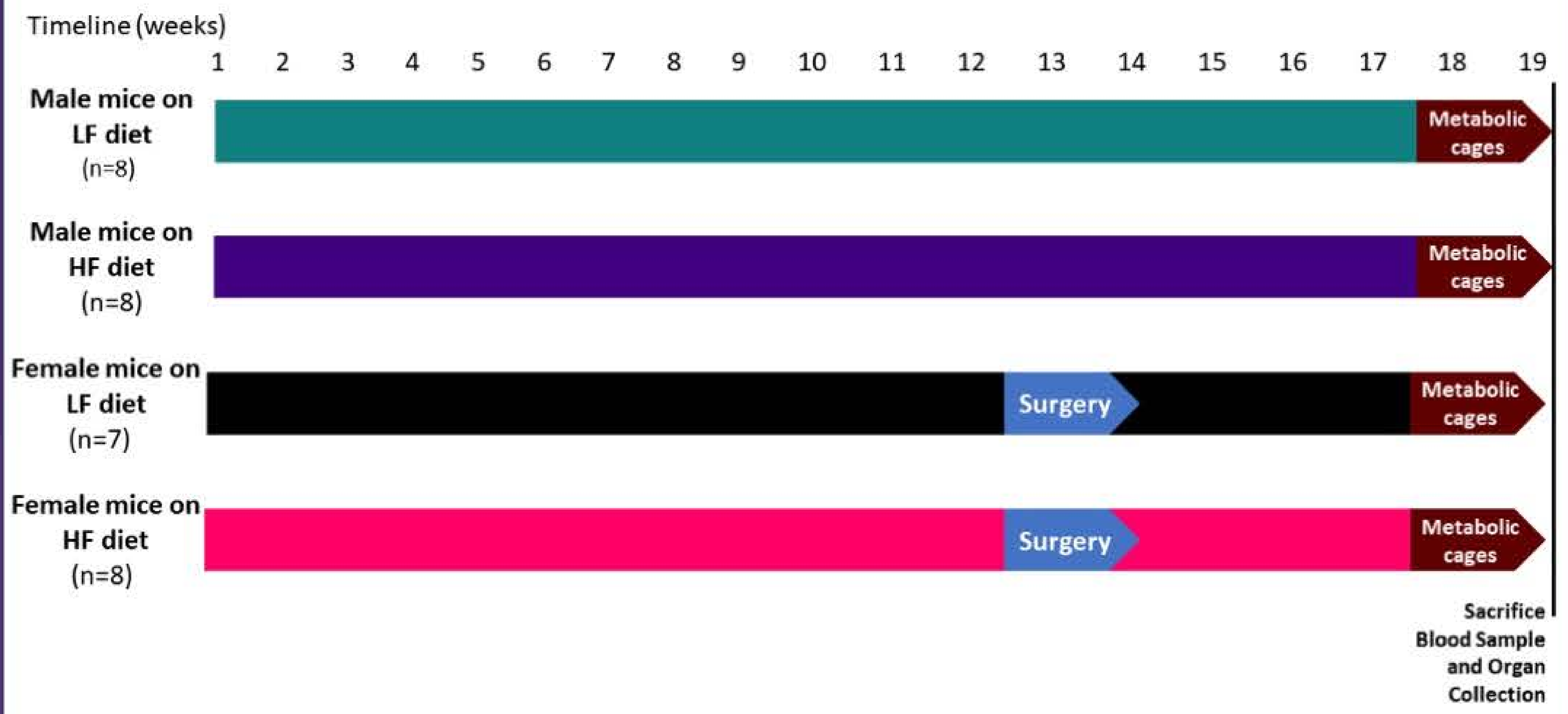
The prevalence of obesity has reached worldwide pandemic dimensions, and its incidence is increased with aging, peaking between ages of 50 to 65 [1]. The World Health Organization defines obesity as BMI>30 kg/m$^2$ and describes it as an excessive fat accumulation associated with increased health risk.

Obesity, especially in combination with its complications such as diabetes, and hypertension, is a mayor risk factor for the onset of chronic kidney disease (CKD) [2] and CKD development and/or progression becomes more common with increasing age. Furthermore, many conditions causing kidney injury are age-dependent, including diabetes and hypertension [3].

Therefore, CKD prevalence has increased dramatically with the worldwide increase in obesity and aging of the population [2-4]. Understanding the action of these factors on kidney function may help prevent or delay the onset of CKD, or in the case of established CKD, help slow progression or reduce related morbidity and mortality.

To study the combined action of obesity and aging on the development of CKD, we generated a diet-induced obesity mouse model of 58-week-old animals. Here, we present results from measurements of body weight, food intake and blood pressure in male and female mice obtained to characterize our animal model.

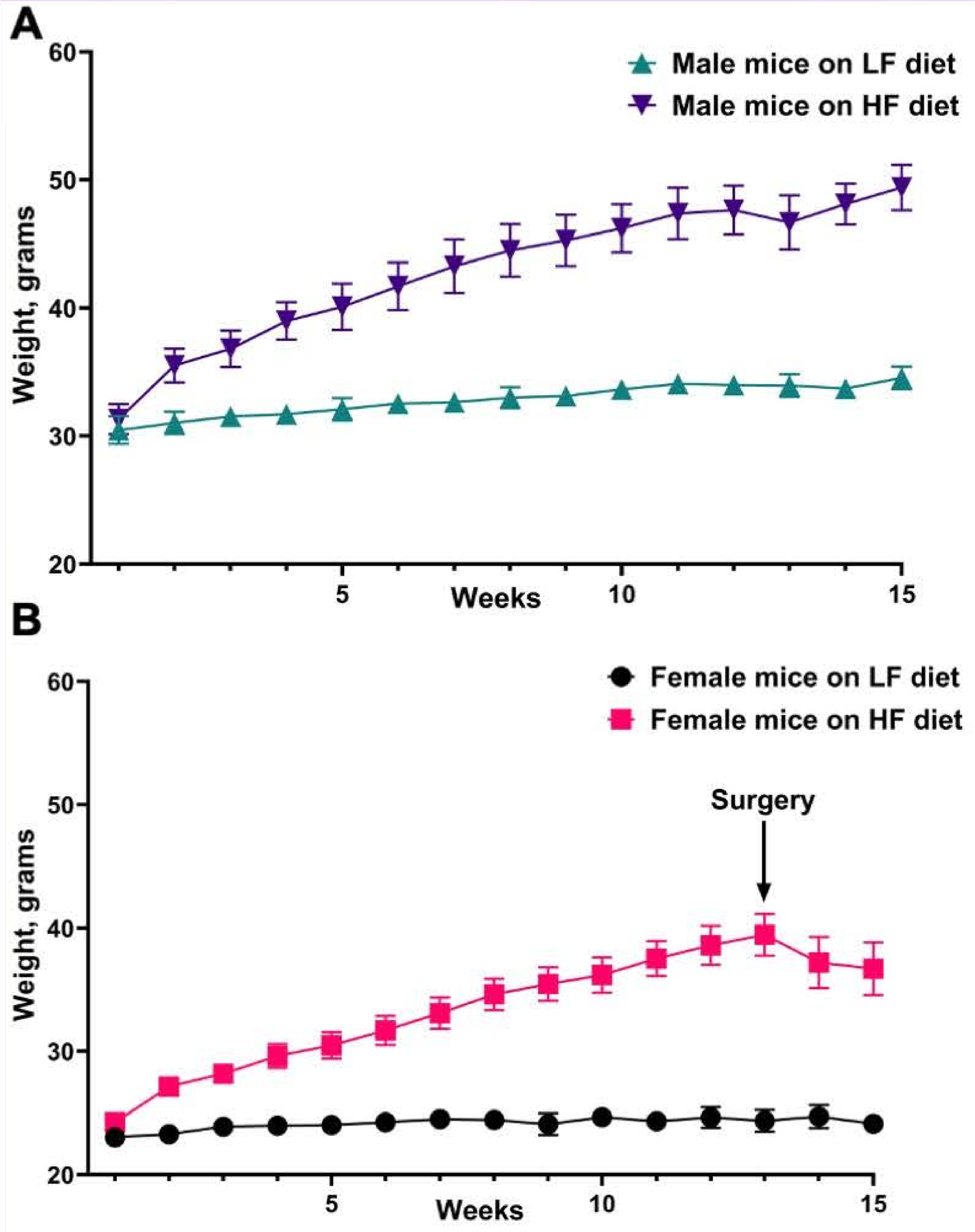
## Methods




*Mouse Models and Surgical Procedures.* 39-week-old male and female C57B6/L mice (Jackson Laboratories, Bar Harbor, MI) were placed on a 60% high fat (HF) or 10% low fat (LF) diet for 19 weeks. The mice's weight and food intake were monitored weekly. At week 14, female mice from both groups were either ovariectomized (OVX) or SHAM-operated (SHAM). At week 18, the mice from all groups were placed in metabolic cages. Systolic blood pressure was measured in all groups of mice at week 14 and at week 19 respectively, using the CODA mouse tail-cuff system (Kent Scientific, Torrington, CT).

## Results

A steady gain in body weight was measured in both male and female mice on HF diet compared to mice on LF diet (Figure 1 A and Figure 1B). The body weight gain in female mice on HF diet was more pronounced than in male mice (Figure 1C, 62% female vs. 54% male). A more pronounced body weight gain in female mice when compared to male mice was not dependent on an increase in caloric intake (Figure 2A – male mice and Figure 2B – female mice). Systolic blood pressure (SBP) was higher in female mice than in male mice on the LF diet (Figure 3A). The SBP did not change in female mice on HF diet when compared to female mice on LF diet while it increased significantly in male mice on HF diet when compared to male mice on LH diet (Figure 3A). An ovarian hormone deficiency state was induced in female mice by ovariectomy in conjunction with the physiological decrease in ovarian hormones induced by aging. In female mice on HF diet, we measured an increase in SBP 4-5 weeks after ovariectomy compared to sham-operated controls (Figure 3B). No changes in SBP were measured after 4-5 weeks of surgery in the same groups of mice on LF diet (Figure 3B).



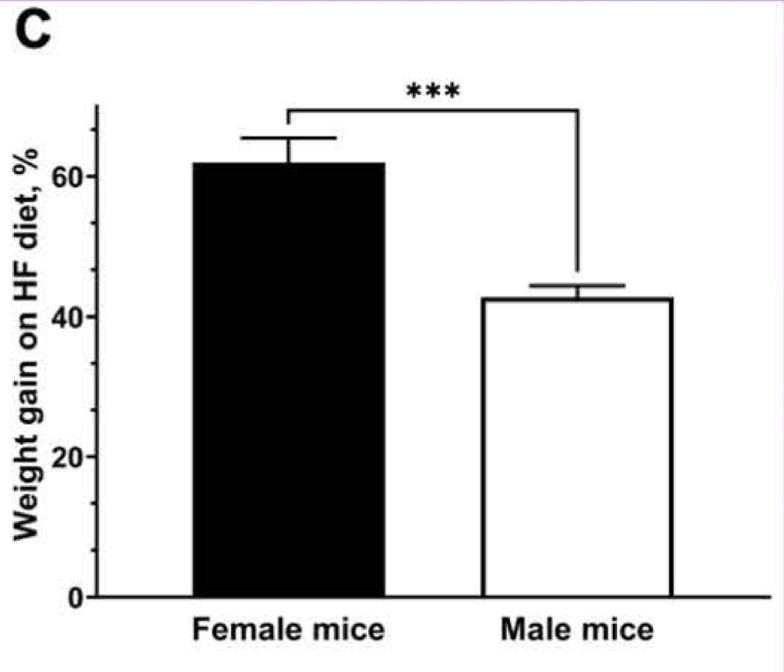




**Figure 1. Body Weight in Female and Male Mice on HF and LF Diets.** Measurements of body weight collected over a 15-week-period. After 15 weeks on the respective diets, mice underwent metabolic studies (data on body weight during this period are not shown): **A.** male mice on HF diet or LF diet (n= 8), **B.** female mice on the same diets (n= 7 mice on LF and 8 mice on HF diet). An arrow in the graph indicates the time when female mice underwent surgery (ovariectomy vs. sham-operation), **C.** Differences in body weight gain in female vs. male mice on HF diet.

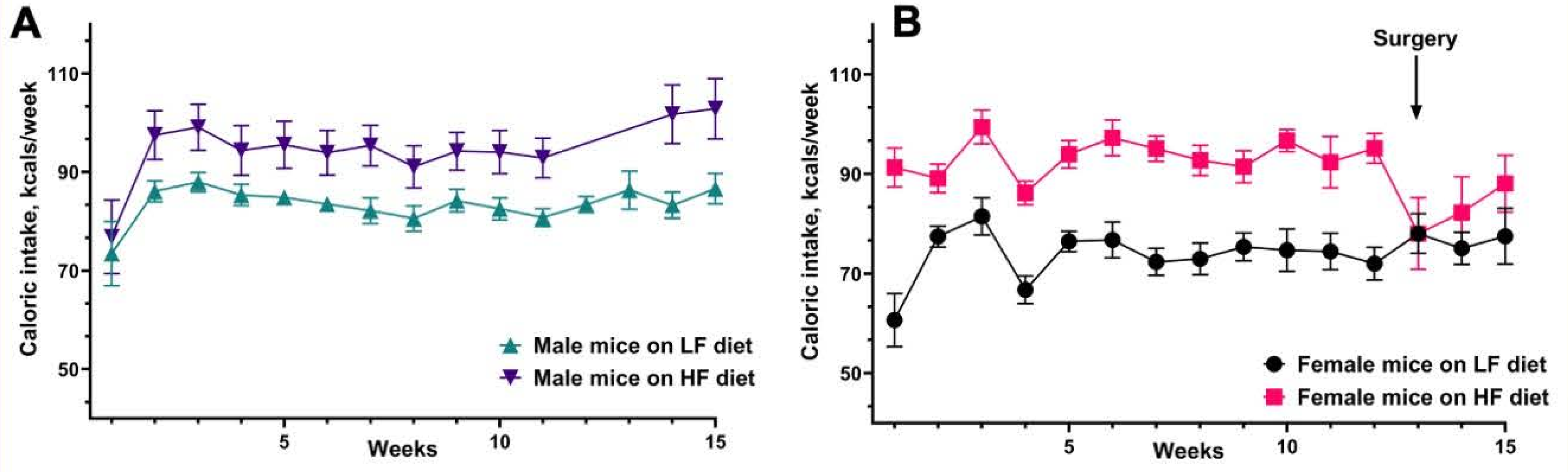



**Figure 2. Caloric Intake in Female and Male Mice on HF and LF Diets.** Measurements of caloric intake collected over a 15-week-period. After 15 weeks on the respective diets, mice underwent metabolic studies (data on caloric intake during this period are not shown): **A.** male mice on HF diet or LF diet (n= 8); **B.** female mice on the same diets (n= 7 mice on LF and 8 mice on HF diet). An arrow in the graph indicates the time when female mice underwent surgery (ovariectomy vs. sham-operation).

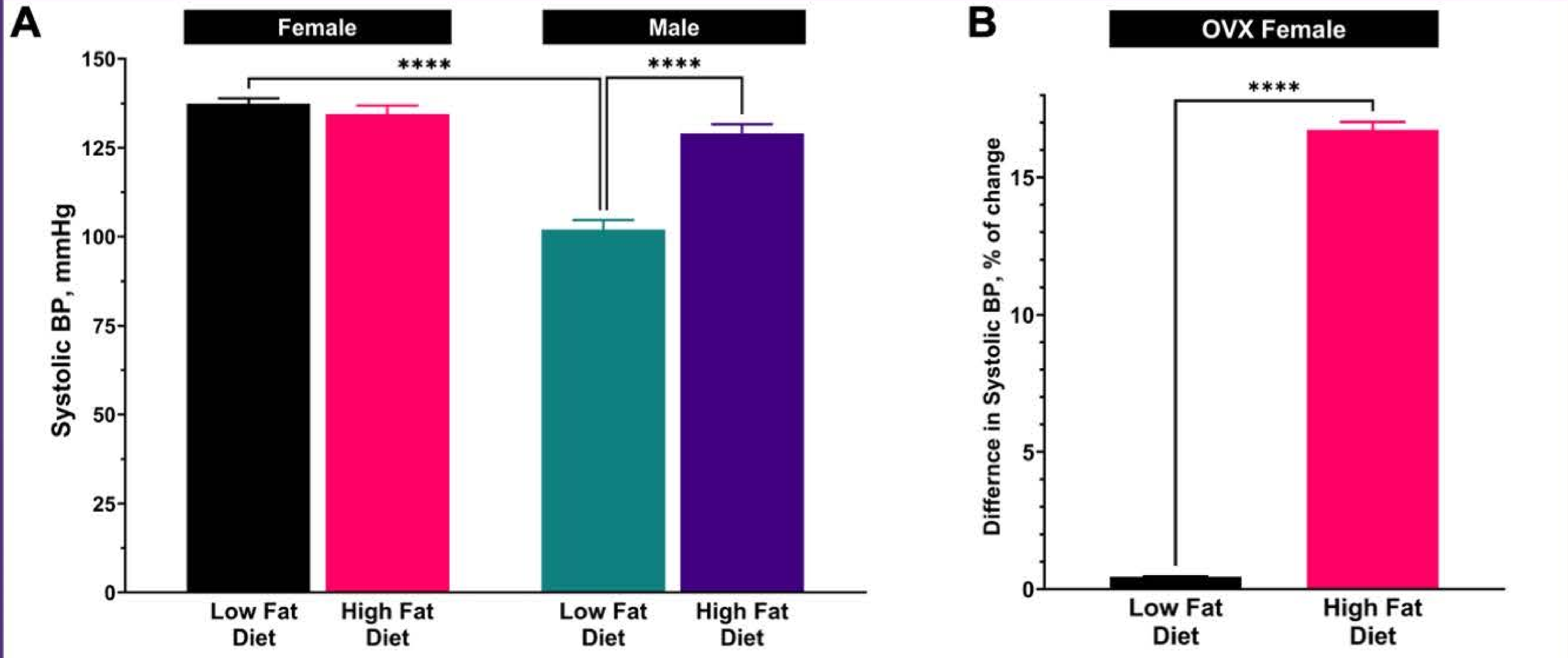



**Figure 3. Systolic Blood Pressure in Female and Male Mice on HF and LF Diets**. **A**. Systolic blood pressure (SBP) measurements in female and male mice. Mice were fed with HF diet or LF diet, respectively (n= 7-8 mice per group). **B**. Differences in SBP in ovariectomized female mice fed with HF or LF diet (n= 7 mice on LF diet and 8 mice in HF diet). Results of SBP are expressed as mean ± SEM (ANOVA; ****$p \leq 0.0001$).

## Summary/Conclusion

- Female mice on HF diet had a more pronounced body weight gain when compared to male mice. The body weight gain was not dependent on an increase in caloric intake.
- Female mice on LF diet had higher SBP than male mice on the same diet. HF diet induced an increase in SBP when compared to LF diet in male mice only.
- SBP increased after ovariectomy only in female mice on HF diet.

**These results indicate sex differences in the control of body weight and blood pressure in a model of diet-induced obesity.**

## References

1. Boutari, C. and C.S. Mantzoros, *A 2022 update on the epidemiology of obesity and a call to action: as its twin COVID-19 pandemic appears to be receding, the obesity and dysmetabolism pandemic continues to rage on.* Metabolism, 2022. **133**: p. 155217.
2. Kovesdy, C.P., et al., *Obesity and Kidney Disease: Hidden Consequences of the Epidemic.* Can J Kidney Health Dis, 2017. **4**: p. 2054358117698669.
3. Mallappallil, M., et al., *Chronic kidney disease in the elderly: evaluation and management.* Clin Pract (Lond), 2014. **11**(5): p. 525-535.
4. Prasad, R., R.K. Jha, and A. Keerti, *Chronic Kidney Disease: Its Relationship With Obesity.* Cureus, 2022. **14**(10): p. e30535.