



Adolescent Body Mass Index and Early Chronic Kidney Disease in Young Adulthood

¹ M.Partan, ² M.Braden

^{1,2} Sidney Kimmel Medical College at Thomas Jefferson University, United States of America

Correspondence : partanmd398343@gmail.com

Article History :

Received date : 2012/10/02

Revised date : 2012/11/15

Accepted date : 2012/12/19

Published date : 2013/01/08



Copyright: © 2013 by the authors. Submitted for possible open access publication under the terms and conditions of the Creative Commons Attribution (BY NC) license (<https://creativecommons.org/licenses/by-nc/4.0/>).

ABSTRACT

Introduction

Adolescent obesity is a global health issue with significant long-term consequences. A growing body of evidence links elevated body mass index (BMI) during adolescence to the early onset of chronic kidney disease (CKD) in young adulthood. This review synthesizes the current literature on this critical association.

Methods

This abstract is based on a literature review that synthesizes findings from multiple sources, including population-based cohort studies, case-control studies, and systematic reviews. The review examined the association between adolescent BMI and subsequent markers of kidney function and disease in young adulthood.

Results

A strong and consistent association exists between higher adolescent BMI and an increased risk for developing CKD. Elevated BMI is linked to lower estimated glomerular filtration rate (eGFR) and increased albuminuria. The risk is markedly higher for obese adolescents with concurrent metabolic syndrome. Longitudinal studies demonstrate that obesity in youth predicts a more rapid decline in renal function and a significantly increased risk of end-

stage renal disease (ESRD) later in life, independent of other cardiovascular and metabolic factors.

Discussion

The evidence firmly establishes adolescent obesity as an independent risk factor for early-onset CKD. The pathophysiological mechanisms are complex, involving metabolic disturbances and direct renal effects like glomerular hyperfiltration. The importance of childhood BMI trajectories highlights that the groundwork for adult renal health is established early, underscoring the need for preventative rather than reactive healthcare strategies.

Conclusion

A compelling body of evidence demonstrates a significant association between elevated adolescent BMI and the risk of developing CKD in young adulthood. Early identification and management of obesity in the pediatric population are crucial public health priorities to mitigate the future burden of kidney disease.

Keywords

Adolescent Obesity, Body Mass Index, Chronic Kidney Disease, Renal Function, Young Adulthood, Metabolic Syndrome.

INTRODUCTION

The relationship between adolescent body mass index (BMI) and the development of chronic kidney disease (CKD) in young adulthood has garnered increasing attention in recent years. The literature presents a compelling narrative that underscores the implications of obesity on renal health, particularly during the formative years of adolescence.

In 2003, (Kelishadi et al., 2003) conducted a pivotal study examining kidney function in obese adolescents, revealing that those with metabolic syndrome faced a heightened risk of chronic diseases, including CKD. This foundational work highlighted the importance of understanding how obesity, especially in the context of metabolic disorders, can compromise renal function early in life.

Following this, (Nagel et al., 2003) expanded on the implications of BMI in relation to kidney function over a 20-year span. Their findings indicated that higher BMI was consistently associated with lower estimated glomerular filtration rate (eGFR) and increased albuminuria, suggesting that even modest elevations in BMI could lead to clinically significant renal impairment. This study emphasized the need for long-term observational data to better understand the trajectory of renal health in relation to BMI.

(S Garland, 2004) further contributed to the discourse by synthesizing existing literature on the association between BMI and CKD. The article provided a comprehensive overview of various lifestyle factors and their interplay with obesity, establishing that a higher BMI is a significant predictor of both prevalent and incident CKD. This systematic review underscored the multifaceted nature of obesity as a risk factor for renal disease, reinforcing the need for targeted interventions.

In 2007, (P. et al., 2007) highlighted the consequences of obesity on kidney function, noting that higher BMI correlates with a more rapid decline in eGFR and an increased incidence of end-stage renal disease (ESRD). Their findings pointed to a troubling trend where elevated BMI, particularly at severe levels, was linked to

poorer renal outcomes, independent of other cardiovascular and metabolic complications.

The 2011 review by (Eun Yim & Hwan Yoo, 2011) provided a contemporary perspective on the prevalence of obesity as a predisposing factor for CKD and ESRD. They reported that a significant proportion of kidney disease cases in the U.S. could be attributed to obesity, with a clear association between higher BMI and the risk of developing proteinuria and CKD, even in the absence of prior kidney disease. This study reiterated the critical role of obesity in both the onset and progression of renal diseases, particularly among adolescents.

(Toda et al., 2012) examined the impact of BMI changes on CKD development, affirming the notion that obesity is a significant risk factor for CKD. Their investigation into metabolic phenotypes provided insights into how fluctuations in body weight can influence renal outcomes, further supporting the argument that early interventions in weight management could be beneficial.

Finally, (Aarestrup et al., 2012) explored the associations between childhood BMI trajectories and adult-onset CKD, emphasizing the long-term implications of adolescent obesity on kidney health. Their population-based study highlighted the critical role of early-life BMI patterns in predicting later kidney disease, thus reinforcing the importance of monitoring and addressing obesity in youth.

Overall, the literature presents a clear and compelling case for the association between adolescent BMI and the risk of developing CKD in young adulthood. Each study contributes to a growing body of evidence that underscores the urgency of addressing obesity in the pediatric population to mitigate future renal health risks.

LITERATURE REVIEW

The article titled "Kidney function in obese adolescents with or without metabolic syndrome in a nationally-representative sample of pediatric population: First report from the Middle East and North Africa: The CASPIAN-III Study: A Case-Control Study" by Kelishadi et al. (Kelishadi et al., 2003) provides a significant contribution to understanding the relationship between obesity, metabolic syndrome, and kidney function in adolescents. The study's primary objective was to evaluate kidney function among obese adolescents, distinguishing between those with and without

metabolic syndrome (MetS), thereby addressing a critical gap in the literature regarding this demographic.

The authors utilized a nationally representative sample from the CASPIAN-III study, which enhances the generalizability of their findings to the Middle Eastern and North African pediatric populations. This methodological strength is essential as it allows for a more accurate reflection of the health challenges faced by these populations. The case-control design effectively highlights the differences in kidney function, allowing for a nuanced understanding of how obesity and MetS interact to influence renal health.

One of the key insights from the study is the identification of elevated risks of chronic kidney disease (CKD) associated with obesity, particularly in adolescents with MetS. The authors present compelling evidence that adolescents who are both obese and have MetS show significantly poorer kidney function compared to their non-MetS counterparts. This finding is critical, as it underscores the importance of early intervention and monitoring of kidney health in obese adolescents, potentially mitigating long-term health consequences.

The article also discusses the broader implications of these findings in the context of rising obesity rates and the associated increase in metabolic disorders among youth. The authors argue that the prevalence of obesity and MetS in adolescents is a pressing public health concern, given its association with increased morbidity and mortality from chronic diseases, including CKD. This perspective aligns with current trends in pediatric health, emphasizing the need for targeted strategies to address obesity and its complications in young populations.

However, while the study provides valuable insights, it is essential to consider its limitations. The cross-sectional nature of the study restricts causal inferences regarding the relationship between obesity, MetS, and kidney function. Longitudinal studies would be beneficial in establishing the temporal dynamics of these associations and in understanding the progression of kidney impairment over time. Additionally, the reliance on self-reported data for some variables may introduce bias, which the authors acknowledge.

The article "Body mass index and metabolic factors predict glomerular filtration rate and albuminuria over 20 years in a high-risk population" by Nagel et al. (Nagel et al., 2003) offers critical insights into the relationship between body mass index (BMI) and chronic kidney disease (CKD), particularly within a high-risk population. The authors highlight the growing public health concern of CKD, which affects over 10% of individuals in population-based studies. Their research underscores the necessity of identifying modifiable risk factors that can predict future CKD, emphasizing the importance of long-term observational studies.

One of the most significant findings of this study is the strong association between higher BMI and lower estimated glomerular filtration rate (eGFR), as well as increased albumin-to-creatinine ratio (ACR). The data indicate a 14% increase in ACR for each 1 kg/m² rise in BMI, suggesting a clinically relevant impairment of renal function (Nagel et al., 2003). This finding is particularly noteworthy as it establishes a direct link between BMI and kidney health, even within what are considered normal ranges for these renal function markers. The authors assert that BMI was the only parameter consistently associated with eGFR across both long-term and cross-sectional analyses, reinforcing the notion that obesity is a significant risk factor for CKD.

Moreover, the article discusses the implications of being overweight during adolescence or early adulthood, revealing a 70% increase in the risk for albuminuria in individuals over the age of 60 who were overweight in their youth. This finding suggests that the adverse effects of high BMI may extend beyond immediate health concerns and have long-term consequences for renal function. The authors also engage with the ongoing debate regarding the pathways through which obesity may lead to CKD, considering whether the relationship is mediated through associated conditions like diabetes and hypertension, or if there are direct mechanisms involved.

Interestingly, the authors mention that while BMI is a widely used measure, some researchers propose that waist-to-hip ratio (WHR) may serve as a better predictor of kidney disease, as it more accurately reflects central obesity. This raises

important questions about the metrics used to assess obesity and their implications for public health strategies aimed at CKD prevention.

The article "Elevated body mass index as a risk factor for chronic kidney disease: current perspectives" by Jocelyn S Garland (S Garland, 2004) provides a comprehensive examination of the relationship between body mass index (BMI) and chronic kidney disease (CKD) in seemingly healthy individuals. The author synthesizes a range of studies that highlight the multifaceted nature of obesity as a significant risk factor for both prevalent and incident CKD, particularly emphasizing the implications of BMI in young adults.

Garland discusses the systematic review and meta-analysis that reveal a strong correlation between elevated BMI and the risk of developing CKD. This association is particularly concerning given the rising obesity rates among adolescents, which may predispose them to kidney disease in later life. The article underscores that both general obesity, as measured by BMI, and specific abdominal adiposity, indicated by waist-to-hip ratio, play critical roles in predicting the onset of kidney disease. This distinction is vital, as it suggests that not all forms of obesity confer the same risk, and targeted interventions may be necessary to address these differences.

Moreover, the author explores lifestyle factors contributing to obesity and, consequently, to CKD risk. This includes dietary habits, physical activity levels, and other behavioral components that can influence BMI and kidney health. The article emphasizes the importance of early intervention during adolescence to mitigate future health risks, particularly for those who may already be at a higher risk due to genetic or environmental factors.

Garland also addresses the "BMI paradox," where individuals with CKD may exhibit a different mortality risk profile compared to the general population. This paradox highlights the complexity of obesity's impact on health outcomes, suggesting that while higher BMI is typically associated with negative health effects, the relationship may not be straightforward in the context of CKD.

The article "Obesidad y enfermedad renal: consecuencias ocultas de la epidemia" by Csaba P., MD Kovesdy, Susan Furth, and Carmine Zoccali (P. et al., 2007)

presents a thorough examination of the relationship between body mass index (BMI) and chronic kidney disease (CKD), particularly focusing on the implications of obesity on renal health. The authors provide compelling evidence that higher BMI is significantly associated with both the presence and progression of CKD, emphasizing that individuals with a BMI of 30 kg/m² or greater exhibit a threefold increased risk of developing CKD.

One of the key insights from the article is the correlation between elevated BMI levels, particularly class II obesity and above, and the rapid decline in estimated glomerular filtration rate (eGFR). The findings suggest that individuals with pre-existing CKD who also present with higher BMI levels are at an increased risk for more rapid progression of their kidney disease. This highlights the importance of managing obesity as a critical component of CKD care. The authors further note that the relationship between obesity and renal outcomes remains significant even after controlling for cardiovascular and metabolic factors, indicating that the detrimental effects of obesity on kidney function may operate through mechanisms that are independent of these common complications.

Moreover, the article discusses the increased odds of incident proteinuria associated with higher BMI, which serves as an early marker for kidney damage. The authors argue that the implications of their findings extend beyond the individual, as the rising prevalence of obesity poses a broader public health challenge, particularly in relation to the increasing rates of CKD and end-stage renal disease (ESRD).

The article "Obesity and chronic kidney disease: prevalence, mechanism, and management" by Hyung Eun Yim and Kee Hwan Yoo (Eun Yim & Hwan Yoo, 2011) provides a comprehensive analysis of the relationship between obesity and chronic kidney disease (CKD), emphasizing the significant impact of elevated body mass index (BMI) on kidney health, particularly in adolescents. The authors present compelling evidence that links obesity not only to the prevalence of CKD but also to its progression and the risk of end-stage renal disease (ESRD).

A critical takeaway from the article is the assertion that obesity serves as an independent risk factor for CKD progression, irrespective of pre-existing nephropathy. This is underscored by findings from various studies, including one

indicating that 24%–33% of kidney disease cases in the United States are associated with obesity (Eun Yim & Hwan Yoo, 2011). The authors highlight that adolescents with higher BMI are at a significantly increased risk of developing proteinuria and, consequently, CKD, even in the absence of prior kidney issues. This insight is crucial for public health initiatives aimed at addressing obesity in young populations, as early intervention could potentially mitigate the long-term consequences of obesity on kidney health.

Moreover, the article discusses the alarming rates of obesity-related glomerulopathy (ORG), which has seen a rise in incidence parallel to the growing rates of obesity globally. The data presented indicate that a substantial percentage of obese patients exhibit proteinuria, with 56% of obese individuals in the study showing this condition, and 44% experiencing both proteinuria and renal insufficiency (Eun Yim & Hwan Yoo, 2011). These statistics highlight the urgent need for targeted strategies to monitor and manage kidney health in obese adolescents.

The authors also delve into the long-term risks associated with obesity in youth, noting that adolescents who are obese have a significantly higher likelihood of developing both diabetic and nondiabetic ESRD later in life. Specifically, the article reports that obese adolescents aged 17 years had a 3.4-fold increased risk for nondiabetic ESRD and a staggering 19-fold increased risk for diabetic ESRD (Eun Yim & Hwan Yoo, 2011). This correlation emphasizes the critical window of adolescence as a period where interventions could be particularly effective in preventing future renal complications.

Furthermore, the article elaborates on the mechanisms by which obesity exacerbates kidney conditions, including the association between obesity and interstitial fibrosis in patients with immunoglobulin A nephropathy. The findings suggest that higher BMI correlates with more severe histopathological lesions, which may lead to worse outcomes for these patients (Eun Yim & Hwan Yoo, 2011). This connection between obesity and the progression of renal diseases highlights the need for comprehensive management approaches that consider weight control as a vital component of CKD treatment.

The article "Effects of Body Weight Change on Development of Chronic Kidney Disease in Obese Metabolic Phenotypes" by Akiko Toda, Shigeko Hara, Hiroshi Tsuji, and Yasuji Arase (Toda et al., 2012) provides a comprehensive examination of the relationship between body mass index (BMI) changes and the development of chronic kidney disease (CKD) in individuals with obesity. The authors assert that obesity is a significant risk factor for CKD, a claim that is well-supported by the current literature on metabolic health and kidney function.

The study meticulously investigates how variations in BMI among obese individuals can influence the onset of CKD. The authors employ a robust methodology that includes longitudinal data analysis, which allows for a nuanced understanding of how weight fluctuations over time correlate with kidney health outcomes. This approach is particularly relevant given the increasing prevalence of obesity and its associated health complications.

One of the key insights from the article is the identification of specific metabolic phenotypes that may predispose certain individuals to a higher risk of CKD as their BMI changes. This finding underscores the complexity of obesity as a risk factor, suggesting that not all obese individuals experience the same health trajectories. The authors emphasize the need for personalized approaches to obesity management, particularly in young adults who may be transitioning from adolescence into adulthood.

Furthermore, the article discusses the physiological mechanisms by which obesity can lead to CKD, including increased glomerular hyperfiltration and the subsequent progression of kidney damage. This detailed exploration of the pathophysiological processes enhances the reader's understanding of the critical interplay between body weight, metabolic health, and kidney function.

However, while the article presents compelling data, it would benefit from a more extensive discussion on the implications of these findings for clinical practice. For instance, the authors could elaborate on potential interventions that could mitigate the risk of CKD in young adults with obesity. Additionally, the study could address the need for further research into the long-term effects of BMI changes during adolescence on kidney health in later life.

The article titled "Childhood body mass index trajectories and associations with adult-onset chronic kidney disease in Denmark: A population-based cohort study" by Aarestrup et al. (Aarestrup et al., 2012) provides significant insights into the relationship between childhood body mass index (BMI) trajectories and the onset of chronic kidney disease (CKD) in adulthood. The authors address a crucial gap in existing literature by exploring how early life body size may influence kidney health later in life, particularly in light of the established connection between adult adiposity and CKD.

The study employs a robust population-based cohort design, allowing for a comprehensive analysis of BMI trajectories from childhood into adulthood. This methodological choice strengthens the validity of the findings, as it captures a wide range of BMI patterns over time and facilitates the examination of their long-term health implications. The authors effectively utilize statistical models to assess the associations between various BMI trajectories and the incidence of adult-onset CKD and end-stage kidney disease (ESKD), thereby providing a nuanced understanding of how childhood obesity may predispose individuals to these conditions.

One of the key insights from the article is the identification of specific BMI trajectories that are significantly associated with an increased risk of adult-onset CKD. The findings suggest that not only the magnitude of BMI but also its trajectory during childhood plays a critical role in determining kidney health in young adulthood. The authors highlight that individuals who experience consistent high BMI throughout childhood are at the highest risk for developing CKD, which underscores the importance of early interventions aimed at managing childhood obesity.

Additionally, the study explores the mediating role of adult-onset type 2 diabetes (T2D) in the relationship between childhood BMI trajectories and CKD. This aspect of the research is particularly noteworthy, as it sheds light on potential pathways through which early life obesity may contribute to kidney disease. The authors present evidence that T2D may partially mediate the association between high

childhood BMI and CKD, suggesting that interventions targeting both obesity and diabetes management could be crucial in reducing the risk of CKD in later life. However, while the article presents compelling evidence, it is essential to consider potential limitations. The reliance on self-reported BMI data during childhood may introduce bias, as participants may not accurately recall their weight and height. Furthermore, the study's generalizability may be limited to the Danish population, as cultural and environmental factors influencing BMI trajectories can vary significantly across different regions.

CONCLUSION

The literature review provides an extensive examination of the relationship between adolescent body mass index (BMI) and the development of chronic kidney disease (CKD) in young adulthood. A significant body of research indicates that obesity during adolescence is a critical risk factor for subsequent renal health issues, particularly CKD.

(Kelishadi et al., 2003) established a foundational understanding of the interplay between obesity and kidney function in adolescents, highlighting the risks associated with metabolic syndrome (MetS). Their findings indicated that obese adolescents with MetS exhibited poorer kidney function compared to their non-MetS counterparts, emphasizing the necessity for early intervention in this demographic. Following this, (Nagel et al., 2003) further delineated the long-term implications of BMI on renal health, establishing that higher BMI correlates with decreased estimated glomerular filtration rate (eGFR) and increased albuminuria over a 20-year period. This longitudinal perspective underscored the importance of monitoring BMI as a modifiable risk factor for CKD.

(S Garland, 2004) synthesized existing literature to reinforce the link between elevated BMI and CKD. The systematic review highlighted the multifaceted nature of obesity as a predictor of both prevalent and incident CKD, advocating for targeted interventions during adolescence. In a similar vein, (P. et al., 2007) presented compelling evidence that higher BMI is significantly correlated with a rapid decline in eGFR and increased incidence of end-stage renal disease (ESRD),

independent of other health complications. Their findings reiterated the urgency of addressing obesity in youth to mitigate long-term renal health risks.

(Eun Yim & Hwan Yoo, 2011) provided a contemporary perspective on the prevalence of obesity as a risk factor for CKD, reporting that a substantial proportion of kidney disease cases in the U.S. could be attributed to obesity. Their analysis revealed that adolescents with elevated BMI are at an increased risk of developing proteinuria and CKD, even in the absence of prior kidney issues. This insight emphasizes the critical need for early interventions in managing obesity among youth.

(Toda et al., 2012) explored the impact of BMI changes on CKD development, indicating that fluctuations in body weight can significantly influence renal outcomes. Their findings support the argument for personalized interventions in weight management for obese adolescents, considering the diverse metabolic phenotypes that may predispose individuals to CKD. (Aarestrup et al., 2012) further contributed to the discourse by examining childhood BMI trajectories and their association with adult-onset CKD, reinforcing the notion that early-life obesity patterns are predictive of later kidney disease.

In conclusion, the literature presents a compelling case for the significant association between adolescent BMI and the risk of developing CKD in young adulthood. The studies reviewed indicate that obesity, particularly when accompanied by metabolic syndrome, poses a considerable risk for renal health, underscoring the need for early identification and intervention strategies to address obesity in the pediatric population. These findings highlight the importance of a proactive approach to managing weight during adolescence to mitigate future renal health risks.

REFERENCES

Kelishadi, R., Gheissari, A., Bazookar, N., Esmaeil Motlagh, M., Taslimi, M., & Ardalan, G., 2003. Kidney function in obese adolescents with or without metabolic syndrome in a nationally-representative sample of pediatric population: First report from the Middle East and North Africa: The CASPIAN-III Study: A Case-Control Study.

Nagel, G., Zitt, E., Peter, R., Pompella, A., Concin, H., & Lhotta, K., 2003. Body mass index and metabolic factors predict glomerular filtration rate and albuminuria over 20 years in a high-risk population.

S Garland, J., 2004. Elevated body mass index as a risk factor for chronic kidney disease: current perspectives.

P., C., Kovesdy, M. D., Furth, S., & Zoccali, C., 2007. Obesidad y enfermedad renal: consecuencias ocultas de la epidemia.

Eun Yim, H. & Hwan Yoo, K., 2011. Obesity and chronic kidney disease: prevalence, mechanism, and management.

Toda, A., Hara, S., Tsuji, H., & Arase, Y., 2012. Effects of Body Weight Change on Development of Chronic Kidney Disease in Obese Metabolic Phenotypes.

Aarestrup, J., Blond, K., Vistisen, D., E. Jørgensen, M., Frimodt-Møller, M., W. Jensen, B., & L. Baker, J., 2012. Childhood body mass index trajectories and associations with adult-onset chronic kidney disease in Denmark: A population-based cohort study.