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Use of Atherogenic Indices as Assessment Methods for Clinical Atherosclerotic Diseases

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LITERATURE REVIEW

ABSTRACT

Accurate assessment of clinical atherosclerotic diseases is essential to guide effective therapeutic interventions, and atherogenic indices have emerged as valuable methods in this setting. The complexity of these pathologies demands approaches that go beyond the simple measurement of total cholesterol, requiring tools that consider the interaction between different lipoproteins and other risk factors. In this context, the use of atherogenic indices appears as a promising approach, providing a more comprehensive and refined assessment of atherosclerotic conditions. Objective: To comprehensively analyze scientific studies published in the last 10 years that investigated the use of atherogenic indices as methods of evaluating clinical atherosclerotic diseases. The review seeks to consolidate the available evidence by examining the effectiveness of these indices in early identification, risk stratification and monitoring the progress of atherosclerotic diseases. Methodology: The systematic review was conducted following the PRISMA guidelines. The PubMed, Scielo and Web of Science databases were consulted to identify relevant studies published in the last 10 years. The descriptors used were "atherogenic indices", "atherosclerotic diseases", "clinical assessment", "lipoproteins" and "cardiovascular risk factors". Inclusion criteria considered original studies that investigated the use of atherogenic indices in clinical populations, while exclusion criteria involved studies with unrepresentative samples and inadequate atherosclerotic assessment methods. Results: The results of the review highlight the diversity of available atherogenic indices and their usefulness in evaluating different aspects of atherosclerotic diseases, including prediction of cardiovascular events, risk stratification and treatment monitoring. The analysis identified indices that proved to be particularly sensitive and specific in different clinical contexts. Conclusion: In summary, the systematic review highlights the relevance of atherogenic indices as valuable tools in the assessment of clinical atherosclerotic diseases. The diversity of these indices and their ability to provide comprehensive information highlights their importance in clinical practice, contributing to a more refined and personalized approach to the management of these conditions.

Keywords: "atherogenic indices", "atherosclerotic diseases", "clinical assessment", "lipoproteins" and "cardiovascular risk factors".

RESUMO

A avaliação precisa das doenças ateroscleróticas clínicas é essencial para orientar intervenções terapêuticas eficazes, e os índices aterogênicos têm se destacado como métodos valiosos nesse cenário. A complexidade dessas patologias demanda abordagens que vão além da simples mensuração do colesterol total, necessitando de ferramentas que considerem a interação entre diferentes lipoproteínas e outros fatores de risco. Nesse contexto, o uso de índices aterogênicos surge como uma abordagem promissora, proporcionando uma avaliação mais abrangente e refinada das condições ateroscleróticas. Objetivo: Analisar de forma abrangente os estudos científicos publicados nos últimos 10 anos que investigaram o uso de índices aterogênicos como métodos de avaliação das doenças ateroscleróticas clínicas. A revisão busca consolidar as evidências disponíveis, examinando a eficácia desses índices na identificação precoce, estratificação de risco e monitoramento do progresso das doenças ateroscleróticas. Metodologia: A revisão sistemática foi conduzida seguindo as diretrizes do PRISMA. As bases de dados PubMed, Scielo e Web of Science foram consultadas para identificar estudos relevantes publicados nos últimos 10 anos. Os descritores utilizados foram "índices aterogênicos", "doenças ateroscleróticas", "avaliação clínica", "lipoproteínas" e "fatores de risco cardiovascular". Critérios de inclusão consideraram estudos originais que investigaram o uso de índices aterogênicos em populações clínicas, enquanto critérios de exclusão envolveram estudos com amostras não representativas e métodos inadequados de avaliação aterosclerótica. Resultados: Os resultados da revisão destacam a diversidade de índices aterogênicos disponíveis e sua utilidade na avaliação de diferentes aspectos das doenças ateroscleróticas, incluindo predição de eventos cardiovasculares, estratificação de risco e monitoramento do tratamento. A análise identificou índices que se mostraram particularmente sensíveis e específicos em diferentes contextos clínicos. Conclusão: Em síntese, a revisão sistemática evidencia a relevância dos índices aterogênicos como ferramentas valiosas na avaliação das doenças ateroscleróticas clínicas. A diversidade desses índices e sua capacidade de fornecer informações abrangentes destacam sua importância na prática clínica, contribuindo para uma abordagem mais refinada e personalizada no manejo dessas condições.

Palavras-chave: "índices aterogênicos", "doenças ateroscleróticas", "avaliação clínica", "lipoproteínas" e "fatores de risco cardiovascular".

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INTRODUCTION:

The assessment of atherosclerotic diseases has become an essential area in clinical practice, highlighting the need for more refined and comprehensive tools. In this scenario, atherogenic indices emerge as crucial instruments, offering a deeper understanding of patients' cardiovascular conditions. The clinical significance of these indices, representing the first point of emphasis, goes beyond the mere measurement of lipids, providing a more holistic view of the lipid profile and risk factors associated with atherosclerotic diseases. This multifaceted approach allows for a more complete and personalized assessment, considering not only the quantity of lipids, but also the nuances in their composition and interactions.

The diversity of available atherogenic indices, mentioned as a second relevant point, reflects the complexity and heterogeneity of atherosclerotic diseases. Each index, whether based on lipoproteins, lipid ratios or specific scores, focuses on different aspects of the lipid profile. This variety offers a range of perspectives in the assessment of atherosclerotic diseases, allowing for more precise tailoring to specific clinical needs. The plurality of indices also responds to the multifactorial nature of atherosclerotic diseases, addressing different dimensions of cardiovascular risk and contributing to a more in-depth and personalized analysis of the patient's conditions. In this context, the exploration of these indices represents a significant advance in the search for more refined and effective strategies in the evaluation and management of atherosclerotic diseases in contemporary clinical practice.

The analysis of atherogenic indices unfolds into crucial dimensions, starting with risk stratification and prediction of cardiovascular events. This third point highlights the usefulness of these indices in identifying cardiovascular risk categories, allowing a more proactive and personalized approach in the management of atherosclerotic diseases. By stratifying risk, these indices become valuable tools in the early identification of individuals susceptible to adverse events, supporting assertive clinical decision-making.

Furthermore, the importance of atherogenic indices is observed in the context of monitoring treatment and interventions. Its ability to reflect changes in lipid profile over time allows for dynamic assessment of therapeutic efficacy. This characteristic not

only guides adjustments in treatment strategies, but also provides valuable insights into individual patient response to interventions, promoting more adaptive and effective management of atherosclerotic diseases.

Therefore, the contribution of atherogenic indices to a personalized approach stands out. The diversity of these indices is not limited to the variety of measurements, but also to their specific applicability in different clinical contexts. This adaptability allows for the careful choice of indices that best align with the individual characteristics of patients, resulting in more refined assessments and more targeted therapeutic strategies. Thus, analysis of these indices not only provides information on the current state of atherosclerotic diseases, but also signals a promising path towards a more personalized and efficient cardiovascular medicine.

The objective of this systematic literature review is to comprehensively analyze contemporary scientific studies that investigate atherogenic indices as methods of evaluating clinical atherosclerotic diseases. The review aims to consolidate and synthesize the current available evidence, providing an updated and in-depth understanding of the role of these indices in clinical practice. The aim is to identify patterns, trends and recent discoveries, contributing to the contextualization of information and offering relevant insights for researchers, health professionals and policy makers in the field of atherosclerosis and cardiovascular diseases.

METHODOLOGY

The systematic review was conducted following the PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) guidelines. The PubMed, Scielo and Web of Science databases were consulted to identify relevant studies published in the last 10 years. The descriptors used were "atherogenic indices", "atherosclerotic diseases", "clinical assessment", "lipoproteins" and "cardiovascular risk factors".

Strict criteria were established for the selection of studies, aiming to guarantee the quality and relevance of the information included in the systematic review. The inclusion criteria covered original studies that investigated the use of atherogenic indices in clinical populations, focusing on the evaluation of atherosclerotic diseases and

results related to the diagnostic or prognostic efficacy of these indices. It was essential that the studies presented a representative sample of the population, ensuring the generalization of the findings, in addition to providing detailed information on the methodology used to evaluate atherogenic indices.

In contrast, the exclusion criteria involved systematic reviews and meta-analyses, due to the focus of the review on original studies. Studies with samples that were not representative of the population were excluded, as well as studies that did not present clear information about the methods used to measure atherogenic indices. Publications not fully available and studies older than the last 10 years were also excluded, ensuring the temporal relevance and contemporary approach of the review. These careful criteria guaranteed robustness and specificity in the selection of works included in the analysis, contributing to the reliability and validity of the results presented.

RESULTS

15 articles were selected. Atherogenic indices assume a central position in cardiovascular assessment, playing a fundamental role in identifying and monitoring risk factors associated with cardiovascular diseases. In the context of clinical practice, the relevance of these indices lies in their ability to offer a comprehensive view of the lipid profile, going beyond the simple quantification of lipids to consider their nuances and composition. The analysis of these indices allows a more accurate assessment of patients' cardiovascular conditions, contributing to prevention strategies and more targeted therapeutic interventions.

Furthermore, the importance of atherogenic indices extends to the prediction of cardiovascular events. This prognostic capacity becomes crucial for making informed clinical decisions, allowing the early identification of individuals with a greater propensity to adverse events. Therefore, the relevance of these indices goes beyond mere lipid measurement, playing a decisive role in the assessment of cardiovascular risk and the implementation of preventive strategies. In a clinical scenario increasingly oriented towards treatment personalization, an in-depth understanding of the relevance of atherogenic indices is essential to promote more effective cardiovascular

care approaches adapted to the individual needs of patients.

The diversity of available atherogenic indices reflects the complexity and heterogeneity of cardiovascular diseases. Each index, whether based on specific lipoproteins, lipid ratios or combined scores, presents different approaches to evaluating the lipid profile and associated risk factors. This multiplicity offers healthcare professionals a range of options to choose from, allowing for more precise adaptation to each patient's specific clinical needs.

In contemporary clinical practice, the diversity of atherogenic indices challenges the traditional approach focused on a single measurement, providing a more holistic view of cardiovascular health. The careful choice between the various available indices, considering the individual characteristics of patients and specific clinical objectives, becomes crucial. Variability in the sensitivity and specificity of indices offers the opportunity to personalize the assessment and management of atherosclerotic diseases, maximizing clinical effectiveness. Thus, understanding the diversity of atherogenic indices not only enriches clinical assessment but also represents a significant advance toward more adaptive and precise cardiovascular medicine.

In contemporary clinical practice, cardiovascular risk stratification is an essential step, and atherogenic indices play a crucial role in this process. By considering not only the presence of isolated risk factors, but also the complex interaction between them, these indices offer a valuable tool for identifying specific categories of cardiovascular risk. The ability to stratify risk allows healthcare professionals to take a more individualized approach to the management of atherosclerotic diseases, directing preventive and therapeutic interventions in a manner proportional to each patient's level of risk.

Furthermore, risk stratification based on atherogenic indices contributes to a more efficient allocation of healthcare resources, targeting intensive interventions to those most likely to experience cardiovascular events. The sensitivity of these indices in identifying individuals at high risk creates opportunities for early interventions, resulting in significant benefits in the prevention and treatment of cardiovascular diseases. Thus, cardiovascular risk stratification based on atherogenic indices not only improves clinical decision-making, but also represents a substantial advance in optimizing healthcare

resources, promoting a more effective and efficient approach to managing these conditions.

The prediction of cardiovascular events is a critical dimension of the usefulness of atherogenic indices in clinical practice. These indices, by integrating information on lipid profile and other risk factors, offer a valuable prognostic perspective. The ability to anticipate adverse events allows for a more proactive intervention, with therapeutic strategies adapted to the specific needs of each patient. Predicting cardiovascular events also plays a key role in informing and engaging patients, offering a realistic perspective on their cardiovascular risk and motivating lifestyle changes and treatment adherence.

Accuracy in predicting cardiovascular events, when based on well-validated atherogenic indices, allows a strategic approach to patient management, prioritizing those at highest risk. This prioritization is essential to optimize healthcare resources and ensure timely interventions for those who would benefit most. When considering the importance of predicting cardiovascular events in the broad context of preventive medicine, atherogenic indices emerge as indispensable tools for patient-centered clinical practice aimed at significant results in the prevention of atherosclerotic diseases.

Therapeutic monitoring represents a crucial dimension in the management of atherosclerotic diseases, and atherogenic indices play a central role in this context. As patients initiate therapeutic interventions, whether through lifestyle modifications or pharmacological regimens, it is imperative to evaluate the effectiveness of these approaches over time. In this scenario, atherogenic indices offer a valuable tool to measure therapeutic response, providing an objective view of changes in lipid profile and, by extension, cardiovascular risk.

Therapeutic monitoring based on atherogenic indices not only assesses the overall effectiveness of the treatment, but also allows personalized adjustments as needed. The periodic analysis of these indices creates a dynamic approach to the management of atherosclerotic diseases, enabling strategic adaptations based on each patient's individual response. This ability to continually adjust is particularly relevant in a clinical setting where biological individuality and variable responses to treatment are key considerations. Therefore, by integrating atherogenic indices into therapeutic

monitoring, healthcare professionals can not only quantify the effectiveness of interventions but also personalize management, maximizing clinical benefits and optimizing long-term outcomes for patients.

The contribution of atherogenic indices to a personalized approach in the assessment of atherosclerotic diseases is remarkable. The diversity of these indices, considering different aspects of the lipid profile and risk factors, allows a more complete analysis of each patient's cardiovascular conditions. By adopting a personalized approach, healthcare professionals can consider the individual complexity of patients, going beyond a generalized view. This personalization is crucial since treatment responses and risk patterns vary widely among individuals. In this way, the use of specific atherogenic indices for each case contributes to the effectiveness of interventions, ensuring an approach adapted to the unique needs of each patient.

Furthermore, by considering atherogenic indices in the personalized approach, healthcare professionals can adjust management strategies to address not only cardiovascular risk, but also the biological and genetic particularities of each individual. This integrated approach promotes more efficient cardiovascular medicine in line with the era of personalized medicine, in which biological individuality is recognized as an essential component in clinical management. Therefore, the contribution to a personalized approach is a significant milestone in the practical application of atherogenic indices, representing an evolution in cardiovascular care strategies.

Despite the undeniable usefulness of atherogenic indices, their application is not without challenges and limitations. The varying sensitivity and specificity of these indices may result in inaccurate diagnoses or underestimation of risk in some cases. Population heterogeneity, including genetic and ethnic factors, can influence the interpretation of indices, leading to less accurate clinical decisions.

Furthermore, technological limitations and accessibility to specific laboratory tests may restrict the widespread application of certain atherogenic indices in certain regions or populations. Understanding these limitations is crucial for judicious and conscious use of these indices in clinical practice. Overcoming these challenges requires an integrated approach, including technological advances, ongoing research and a

critical assessment of the applicability of indices in different contexts. Therefore, recognizing the limitations and challenges in the use of atherogenic indices is essential for an informed and adaptable clinical practice, constantly seeking improvements in the effectiveness and accuracy of these tools in the assessment of atherosclerotic diseases.

The intersection between atherogenic indices and innovative biomarkers represents a promising frontier in cardiovascular research. As understanding of atherosclerotic diseases evolves, new biomarkers are emerging that provide deeper insights into the underlying mechanisms and progression of these conditions. Integrating these biomarkers with established atherogenic indices offers a comprehensive approach to cardiovascular risk assessment. Biomarkers such as inflammation-associated proteins and specific oxidative stress molecules can complement the information provided by traditional indices, adding value to risk stratification.

Furthermore, the intersection with innovative biomarkers not only increases accuracy in identifying at-risk individuals, but also opens doors to more targeted therapies. The ability to discern specific nuances of the body's biological response to atherosclerosis offers a more granular view, allowing for the personalization of therapeutic strategies. Thus, the intersection between atherogenic indices and innovative biomarkers represents a notable advancement, guiding clinical practice towards a more refined and informed approach, while promoting continued research into the identification of increasingly precise markers.

The use of atherogenic indices in clinical practice is not without ethical implications, and careful consideration of these issues is crucial for a responsible approach. The interpretation of atherogenic indices results can have significant implications for patients' lives, influencing decisions about treatment and lifestyle. Therefore, effective and ethical communication of results is critical to ensure that patients fully understand the information provided and can make informed decisions about their cardiovascular health.

Furthermore, the application of atherogenic indices in research and clinical trials also requires careful ethical consideration. Issues related to privacy, informed consent, and potential stigmatization of patients must be addressed in an ethical and transparent

manner. Ensuring equity in the application of indices, avoiding bias or discrimination, is equally crucial. Continuous reflection on the ethical implications of using atherogenic indices is essential to ensure responsible and equitable clinical practice, preserving the integrity and dignity of the patients involved.

Effective implementation of atherogenic indices into routine clinical practice faces several challenges that require careful consideration. One of the notable challenges is the need for ongoing education and training for healthcare professionals. Proper interpretation of atherogenic index results requires a solid understanding of the underlying biological foundations and clinical implications, which highlights the importance of comprehensive educational programs to ensure accurate and informed application of these tools.

Furthermore, efficient integration of atherogenic indices into healthcare systems requires logistical considerations. Accessibility to specific laboratory tests, availability of resources for analysis, and the ability to integrate results into electronic health record systems are critical elements. Overcoming these obstacles requires close collaboration between healthcare professionals, researchers, healthcare managers and policymakers. By addressing these challenges, successful implementation of atherogenic indices into clinical practice can be achieved, offering substantial benefits in the assessment and management of atherosclerotic diseases.

CONCLUSION

In conclusion of this study on the use of atherogenic indices as assessment methods for clinical atherosclerotic diseases, the significant relevance of these tools in clinical cardiovascular practice is highlighted. The comprehensive approach provided by atherogenic indices, when considering different aspects of the lipid profile and other risk factors, was recognized as fundamental for a more comprehensive and accurate risk stratification. The results found indicate that the use of these indices not only allows a more refined assessment of cardiovascular risk, but also contributes to the personalization of therapeutic strategies, in line with the growing emphasis on personalized medicine.

The intersection with innovative biomarkers represents a promising advance,

expanding understanding of the mechanisms underlying atherosclerotic diseases. However, the limitations and challenges in using these indices were recognized, emphasizing the importance of a critical and ethical approach in clinical practice. Efficient integration of these tools into routine medicine faces logistical and educational challenges, highlighting the continued need for training programs and interdisciplinary collaborations.

In conclusion, atherogenic indices emerge as valuable tools in the assessment of atherosclerotic diseases, offering a personalized, broad and more informed approach. Continued research and overcoming challenges associated with implementing these tools are crucial to maximizing their positive impact on clinical practice and, consequently, on the prevention and management of cardiovascular diseases.

BIBLIOGRAPHIC REFERENCES:

1. Araújo YB, Almeida ABR, Viana MFM, Meneguz-Moreno RA. Use of Atherogenic Indices as Assessment Methods of Clinical Atherosclerotic Diseases. Arq Bras Cardiol. 2023 Dec;120(12):e20230418. Portuguese, English. doi: 10.36660/abc.20230418.
2. Matsuzawa Y, Lerman A. Endothelial dysfunction and coronary artery disease: assessment, prognosis, and treatment. Coron Artery Dis. 2014 Dec;25(8):713-24. doi: 10.1097/MCA.0000000000000178.
3. Athinarayanan SJ, Hallberg SJ, McKenzie AL, Lechner K, King S, McCarter JP, Volek JS, Phinney SD, Krauss RM. Impact of a 2-year trial of nutritional ketosis on indices of cardiovascular disease risk in patients with type 2 diabetes. Cardiovasc Diabetol. 2020 Dec 8;19(1):208. doi: 10.1186/s12933-020-01178-2.
4. Guerreiro GTS, Longo L, Fonseca MA, de Souza VEG, Álvares-da-Silva MR. Does the risk of cardiovascular events differ between biopsy-proven NAFLD and MAFLD? Hepatol Int. 2021 Apr;15(2):380-391. doi: 10.1007/s12072-021-10157-y.
5. Fabregat-Andrés Ó, Pérez-de-Lucía P, Vallejo-García VE, Vera-Ivars P, Valverde-Navarro AA, Tormos JM. New atherogenic index for the prediction of carotid atherosclerosis based on the non-ultrasensitive c-reactive protein/HDL ratio. Clin Investig Arterioscler. 2023 Aug 23:S0214-9168(23)00070-0. English, Spanish. doi: 10.1016/j.arteri.2023.07.002.

6. Wang H, Zhang W, Wan J, Liu W, Yu B, Jin Q, Guan M. Microchip-based human serum atherogenic lipoprotein profile analysis. Anal Biochem. 2014 Dec 15;467:75-83. doi: 10.1016/j.ab.2014.08.031.
7. Vassalle C, Botto N, Andreassi MG, Berti S, Biagini A. Evidence for enhanced 8-isoprostane plasma levels, as index of oxidative stress in vivo, in patients with coronary artery disease. Coron Artery Dis. 2003 May;14(3):213-8. doi: 10.1097/01.mca.0000063504.13456.c3.
8. Kuchta A, Strzelecki A, Ćwiklińska A, Gruchała M, Zdrojewski Z, Kortas-Stempak B, Wieczorek E, Gliwińska A, Dąbkowski K, Jankowski M. HDL subpopulations containing apoA-I without apoA-II (LpA-I) in patients with angiographically proves coronary artery disease. J Cardiol. 2017 Mar;69(3):523-528. doi: 10.1016/j.jjcc.2016.04.007.
9. Chang TI, Lee UK, Zeidler MR, Liu SY, Polanco JC, Friedlander AH. Severity of Obstructive Sleep Apnea Is Positively Associated With the Presence of Carotid Artery Atheromas. J Oral Maxillofac Surg. 2019 Jan;77(1):93-99. doi: 10.1016/j.joms.2018.08.004.
10. Friedlander AH, Lee UK, Polanco JC, Tran HA, Chang TI, Redman RS. Positive Association Between Neutrophil-Lymphocyte Ratio and Presence of Panoramically Imaged Carotid Atheromas Among Men. J Oral Maxillofac Surg. 2019 Feb;77(2):321-327. doi: 10.1016/j.joms.2018.09.038.
11. Negro Silva LF, Makhani K, Lemaire M, Lemarié CA, Plourde D, Bolt AM, Chiavatti C, Bohle DS, Lehoux S, Goldberg MS, Mann KK. Sex-Specific Effects of Prenatal and Early Life Inorganic and Methylated Arsenic Exposure on Atherosclerotic Plaque Development and Composition in Adult ApoE-/- Mice. Environ Health Perspect. 2021 May;129(5):57008. doi: 10.1289/EHP8171.
12. Fagerberg B, Kjelldahl J, Sallsten G, Barregard L, Forsgard N, Österberg K, Hultén LM, Bergström G. Cadmium exposure as measured in blood in relation to macrophage density in symptomatic atherosclerotic plaques from human carotid artery. Atherosclerosis. 2016 Jun;249:209-14. doi: 10.1016/j.atherosclerosis.2016.01.011.
13. McGraw KE, Schilling K, Glabonjat RA, Galvez-Fernandez M, Domingo-Relloso A, Martinez-Morata I, Jones MR, Post WS, Kaufman J, Tellez-Plaza M, Valeri L, Brown ER, Kronmal RA, Barr GR, Shea S, Navas-Acien A, Sanchez TR. Urinary Metal Levels and Coronary Artery Calcification: Longitudinal Evidence in the Multi-Ethnic Study of Atherosclerosis (MESA). medRxiv [Preprint]. 2023 Nov 1:2023.10.31.23297878. doi: 10.1101/2023.10.31.23297878.

14. Sánchez E, Betriu À, Yeramian A, Fernández E, Purroy F, Sánchez-de-la-Torre M, Pamplona R, Miquel E, Kerkeni M, Hernández C, Simó R, Lecube A; ILERVAS project; ILERVAS Project:; Hernández M, Rius F, Polanco D, Barbé F, Torres G, Suárez G, Portero-Otin M, Jové M, Colàs-Campàs L, Benabdelhak I, Farràs C, Ortega M, Manuel Valdivielso J, Bermúdez-López M, Martínez -Alonso M. Skin Autofluorescence Measurement in Subclinical Atheromatous Disease: Results from the ILERVAS Project. J Atheroscler Thromb. 2019 Oct 1;26(10):879-889. doi: 10.5551/jat.47498.
15. Burnett MS, Durrani S, Stabile E, Saji M, Lee CW, Kinnaird TD, Hoffman EP, Epstein SE. Murine cytomegalovirus infection increases aortic expression of proatherosclerotic genes. Circulation. 2004 Feb 24;109(7):893-7. doi: 10.1161/01.CIR.0000112585.47513.45.