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Sedentary Behavior Research Priorities—NHLBI/NIA Sedentary Behavior Workshop Summary

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Introduction and Workshop Purpose

Over the course of 2013, the National Heart, Lung and Blood Institute (NHLBI) and the National Institute on Aging (NIA) collaborated with a multi-national group of expert scientists to convene, host and facilitate a four-part virtual webinar workshop on sedentary behavior. Participants met to evaluate and discuss the current epidemiological, clinical and other relevant literature on sedentary behavior and to identify research priorities relative to preventing cardiovascular disease and mitigating aging-related disability and functional outcomes. The workshop was predicated on findings of insufficient levels of population adherence to current physical activity recommendations (1,12) and the need to address the NHLBI and NIA research portfolio gaps in the area of sedentary behavior.

Scientific Rationale

No consistent definition of sedentary behavior currently exists. However, sitting, lying down, watching television, and participating in other screen-based activities are collectively labeled sedentary behaviors. In general, sedentary behavior consists of activities that do not increase energy expenditure markedly above resting metabolic levels (15). Consequently, they qualify as low energy expenditure activities, (15) which are associated with adverse metabolic and physical health outcomes with prolonged exposure (5,7–11,18). In contrast, high energy expenditure activities confer health benefits with prolonged exposure, and this knowledge undergirds current physical activity recommendations (2,6,17,19). Although physical activity recommendations for moderate-to-vigorous intensity activities are based on strong evidence, they have yet to translate into sustained changes in population-level behaviors. In fact, the majority of the US population is considered mostly inactive and sedentary (2,3,6).

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Conflicts:

The other authors have no potential conflicts.

Yet, the health consequences of sedentary behavior are not clearly understood (4,5,7–11,18). Current knowledge suggests negative associations between sedentary behavior and health outcomes and indicates that the adverse effects associated with sedentary behavior are separate from those associated with low levels of moderate-to-vigorous intensity activities (13,14,). Consequently, a knowledge gap remains regarding the independent effects of sedentary behavior on health outcomes, how sedentary behavior research fits into the vast knowledge base on physical activity, and how current and future knowledge about sedentary behavior can inform future health recommendations.

Framing the Workshop

In an effort to engage all stakeholders, the NHLBI and NIA released a joint “Request for Information (RFI)” in January 2013 entitled “Request for Information (RFI) for High-Priority Research Topics for Sedentary Behavior - NOT-HL-13-166” (16). This RFI sought stakeholders’ perspectives on unanswered research questions in several areas, including approaches needed to evaluate and measure sedentary behavior in different populations, types of interventions and strategies needed to reduce the high prevalence of sedentary behaviors in the U.S., and identification of barriers and opportunities for translating current scientific knowledge into population health improvements. The substantial number of responses NHLBI and NIA received guided the workshop planning, identification of discussion topics and formulation of the four thematic sessions: 1. Epidemiology of Sedentary Behavior; 2. Physiology of Sedentary Behavior and its Relationship to Health Outcomes; 3. Influences on Sedentary Behavior and Interventions to Reduce Sedentary Behavior; and 4. Novel Strategies for Sedentary Behavior Research.

Pre-meeting Activities and Charge to the Key Participants

Leading expert scientists in the four thematic areas were invited to participate as session coordinators, key presenters or audience participants. Teams of five to seven experts developed four or five concise 10-minute presentations, which served as the framework for discussions in each of the four, 2.5-hour virtual meetings. An additional group of invited scientists served as panel discussants for each session and provided summary comments and provocative questions that fostered deeper discussion of key issues. All of the discussions were facilitated by the meeting co-chairs, Dr. Russell Pate and Dr. Roger Fielding.

Workshop Summary

To capture the key findings of the workshop, the meeting chair concluded each session by identifying the two top priority recommendations. Comprehensive summaries of the meetings are presented in four brief white papers that accompany this document, and include the substance of the presentations and discussions, a list of all the recommendations that emerged, and the final two priority recommendations for each session. Each of the white papers also reflects the specific themes discussed in one of the four sessions, and includes substantial input from the session expert scientists and discussants convened for that particular session. As such, the authors of the white papers had the flexibility to present their recommendations in the manner that best captured their sessions’ theme, tone and discussion. Across all sessions, participants varied in their use and definition of the concept

of sedentary behavior. In fact the term ‘sedentary behavior’, ‘sedentary time’, and ‘sedentariness’ were all used to inform the discussions. Consequently, in the interest of authenticity, the four white papers also reflect this variety of usage and perspectives. In the paragraphs below, summaries of the discussions for each of the workshop sessions are presented briefly. However, details with supporting rationale for all the recommendations can be found in the accompanying white papers.

Webinar #1 – The Epidemiology of Sedentary Behavior

The initial workshop session was dedicated to reviewing and discussing several issues basic to the study of sedentary behavior and its impact on health. Much attention was given to definitions of sedentary behavior proposed previously and their implications for measurement of sedentary behavior in research studies. Workshop participants reviewed the current status of epidemiological research that has examined relationships between sedentary behavior and health outcomes and overviewed studies that have examined interactive influences of sedentary behavior and physical activity. They concluded that consensus regarding conceptual and operational definitions of sedentary behavior, better methods for measuring sedentary behavior in research studies, and large-scale prospective observational studies of the effects of sedentary behavior on multiple health outcomes are needed.

Webinar # 2 – Physiology of Sedentary Behavior and its Relationship to Health Outcomes

The second webinar focused on the current state of understanding of the biological/physiological mechanisms that underlie sedentary behavior. Key areas of focus included cardio-metabolic consequences of sedentary behavior, animal models of sedentary behavior or forced inactivity, and the interaction between central neurologic drivers of sedentary behavior and peripheral adaptation and feedback. Limitations in current understanding of the molecular changes that occur with sedentary behavior were noted, in particular the fact that the molecular evidence for sedentary behavior effects is derived primarily from studies of conditions and models of low physical activity. Participants resolved that while low physical activity and sedentary behavior are likely to be related mechanistically, they are distinct entities. Discussion also focused on the need to develop better methodologies to address sedentary behavior, including further investigation of appropriate animal models and systems. Webinar participants identified several key research needs going forward, including understanding the interaction between central and peripheral mediators of sedentary behavior and the resultant biological consequences, understanding the molecular basis for the role of changes in sedentary behavior in accelerating the loss of aerobic capacity, and examining muscle performance with advancing age.

Webinar # 3 – Influences on Sedentary Behavior/Interventions to Reduce Sedentary Behavior

The third webinar focused on intervention strategies designed to reduce sedentary behavior. The main conclusion from this webinar was that interventions targeting sedentary behavior

are conceptually and operationally distinct from interventions targeting physical activity. In reviewing the evidence on at-risk populations (e.g., children, older adults) and levels of intervention (e.g., community, workplace, individual), participants concluded that the needs of populations vary and recommended that future endeavors carefully consider the levels (community, work place, individual) for which interventions are to be developed and the populations to which they are targeted . The complexity of messaging to the public and the biomedical community surrounding the topic of sedentary behavior and a clear need for consensus around this message also were considered. Finally, participants proposed novel approaches to address questions related to the dose-response effects of changing sedentary behavior, the establishment of clinically-meaningful changes in sedentary behavior, and development of more sophisticated tools to quantify sedentary behavior exposure.

Webinar #4 – Novel Strategies for Sedentary Behavior Research

The final workshop session focused on unique and efficient strategies for conducting research on sedentary behavior and health. The workshop examined the need for research on sedentary behavior across a wide range of issues and noted that most of the current evidence linking sedentary behavior to health is based on observational studies. Ultimately, evidence will be needed to establish public health guidelines and public health interventions aimed at reducing sedentary behavior. Much discussion focused on the availability of databases that could support important research on sedentary behavior. These include datasets generated in ongoing large-scale epidemiologic studies in which accelerometry data have been or are being collected. These data, although typically collected for the purpose of measuring physical activity, can be reduced to measure sedentary behavior as well, and thus are a potentially valuable resource for future research in this area. Likewise, patient data included in the electronic health records of large integrated health systems provide opportunities for comparative effectiveness research and observational studies of sedentary behavior in patient populations.

Conclusion

This workshop was convened to engage expert extramural scientists in a series of discussions to identify critical gaps in the literature on sedentary behavior and cardiovascular and aging health outcomes. Themes that cut across the four meeting sessions included the need to develop a consensus definition, validate and standardize assessment methods (both objective and subjective) to provide for accuracy and consistency, and develop appropriate scientific models of research. Other topics included the use of translational models to understand personal, social and environmental determinants of sedentary behavior; development of pragmatic trials using large networks of integrated health systems to aid with measurement, prevalence and incidence data collection; exploring the link between incidence rate and risk factors; and the use of technology. Significant discussions focused on whether sedentary behavior should be considered as a distinct and separate behavior from physical inactivity with separate adverse effects on health. To this end, the workshop summary proposed that future studies should seek to examine the separate and interactive effects of sedentary behavior and moderate-to-vigorous physical activity. In addition, it highlighted the importance of looking at patterns of sedentary

behavior, developing and testing multi-level interventions, and exploring dose-response relationships of sedentary behavior to health outcomes. Participants acknowledged that sedentary behavior presents a unique challenge for which the strategies employed to increase physical activity may not be suited. That notwithstanding, the research community should make concerted efforts to study and understand sedentary behaviors and to intervene to effect positive health outcomes and ensure that appropriate resources be directed to this endeavor.

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