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RESEARCH ARTICLE

Activity and Sedentary Time 10 Years After a Successful Lifestyle Intervention: The Diabetes Prevention Program

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Introduction: This study aims to determine if evidence exists for a lasting effect of the Diabetes Prevention Program (DPP) lifestyle intervention on activity levels by comparing objectively collected activity data between the DPP Outcome Study (DPPOS) cohort and adults from the National Health and Nutrition Examination Survey (NHANES; 2003–2006).

Methods: Average minutes/day of light and moderate to vigorous physical activity (MVPA) and sedentary behavior from ActiGraph accelerometers (collected 2010–2012) were examined (2013–2014) for comparable DPPOS and NHANES subgroups by age, sex, and diabetes status. Longitudinal questionnaire data on leisure activity, collected yearly from DPP baseline to the time of accelerometer measurement (1996–2010; 11.9-year mean follow-up), were also examined to provide support for a long-term intervention effect.

Results: Average minutes/day of accelerometer-derived MVPA was higher in all DPPOS subgroups versus NHANES subgroups of similar age/sex/diabetes status; with values as much as twice as high in some DPPOS subgroups. Longitudinal questionnaire data from DPP/DPPOS showed a maintained increase of 1.24 MET hours/week (p=0.026) of leisure activity in DPPOS participants from all original study arms between DPP baseline and accelerometer recording. There were no consistent differences between comparable DPPOS and NHANES subgroups for accelerometer-derived sedentary or light-intensity activity minutes/day.

Conclusions: More than 10 years after the start of DPP, DPPOS participants performed more accelerometer-measured MVPA than similar adults from NHANES. Longitudinal questionnaire data support the accelerometer-based findings by suggesting that leisure activity levels at the time of accelerometer recording remained higher than DPP baseline levels.

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INTRODUCTION

The Diabetes Prevention Program (DPP) and other large randomized trials have shown that lifestyle interventions including physical activity (PA) and weight loss can delay or prevent Type 2 diabetes in high-risk individuals.[1–8] The DPP lifestyle intervention PA goal was to achieve and maintain 150 minutes/week of moderate to vigorous intensity PA (MVPA)[1,9] and was aligned with nationally recommended PA goals for adults.[10] Although reducing sedentary time was encouraged, there was no explicit sedentary behavior reduction goal.[9,11]

The DPP lifestyle intervention succeeded at increasing MVPA and reducing sedentary time, as assessed by questionnaire, in the lifestyle participants (3.2-year mean follow-up).[11,12] After the DPP ended, participants from all study arms were offered a group-implemented version of the lifestyle intervention and have been followed as part of the DPP Outcomes Study (DPPOS) for more than 10 years since DPP baseline.[13] This extensive follow-up period made it possible to examine whether activity levels over the DPPOS follow-up increased from baseline and were greater than what would be expected in the general population.

The follow-up time in other diabetes prevention trials examining the impact of lifestyle interventions on improving activity is typically shorter than 10 years.[4,6,8,11,12,14] Additionally, the majority of published studies rely solely on self-reported measures of PA.[4,6,8,11,12,14] Self-reported PA, using recall questionnaires, has been shown to be a reasonably valid and reliable method of assessing MVPA and domain-specific sedentary behaviors in adults. However, self-report has been shown to be less valid and reliable for measuring unplanned activities, light-intensity activity (LPA), and total accumulated sedentary behavior.[15,16] Objective methods of measuring PA are arguably a more valid method of recording across all intensities of PA and sedentary behavior.[16–19]

This current effort presents objectively collected activity data from accelerometers, measured more than 10 years after DPP baseline. Comparisons to similar accelerometer data from a national sample of adults participating in the National Health and Nutrition Examination Survey (NHANES) was undertaken to provide context for these data. If a long-term intervention effect existed in DPP, then activity levels in the DPPOS cohort as a whole would be expected to be higher and sedentary behavior would be expected to be lower than those for people of the same sex and of similar age and diabetes status in a population-representative cohort. Additionally, the longitudinal changes in questionnaire-based leisure activity (collected yearly from baseline) in the DPPOS cohort was examined to determine whether observed differences in activity between the DPPOS cohort and NHANES participants could be the result of a successful long-term intervention effect or simply represent baseline differences in activity patterns between the two populations.[20]

METHODS

Study Sample

Participants for this effort were recruited from the DPPOS (2002–present) of the DPP follow-up study (1996–2001) cohort. DPP was a multi-center RCT designed to determine if metformin or lifestyle intervention could prevent or delay Type 2 diabetes in adults at high risk for the disease.[21] The DPP study design, methods, and primary results have been published.[1,21] DPP enrolled 3,234 overweight U.S. adults aged ≥25 years (1996–1999) and ended after an average follow-up of 3.2 years (results published after 2.8 years). Diabetes incidence was reduced in the metformin and lifestyle intervention arms compared with placebo by 31% and 58%, respectively.[1]

After DPP ended, all remaining participants were offered a modified group version of the lifestyle intervention (previously described).[11] The goals of the DPP/DPPOS original and group version interventions were to achieve a 7% weight loss and at least 150 minutes/week of moderate-intensity activity (e.g., brisk walking). This PA goal was aligned with the Surgeon General's recommended PA goal for adults.[10] A total of 2,766 of the remaining 3,150 (88%) participants consented to participate in DPPOS.[13]

The DPPOS Accelerometer Ancillary Study (data collected 2010–2012) was a cross-sectional study conducted in DPPOS participants to obtain objectively measured total time spent in PA and sedentary behaviors using a validated accelerometer (ActiGraph GT3X, Pensacola, FL).[22–25] Twenty-three of the 26 DPP clinical centers (1,932 active participants, all aged ≥39 years) took part. Participants not confined to a wheelchair and able to walk were eligible for inclusion. Informed consent was obtained from all participants and the study was approved by the IRBs of each institution.

Conducted by the National Center for Health Statistics, NHANES is a cross-sectional observational study of the U.S. population. During NHANES 2003–2004 and 2005–2006, measures of PA were collected in a U.S. representative sample using an ActiGraph accelerometer.[26] For comparability to the DPPOS cohort, only participants aged ≥40 years with valid accelerometer data and fasting blood glucose measurements were included in this report.

Measures

DPPOS participants wore an ActiGraph GT3X triaxial accelerometer on their waist for 7 days, during waking hours, following their annual or midyear clinic visit (one time from 2010 to 2012). NHANES study participants received an ActiGraph (AM7164 uniaxial) monitor at their examination visit to wear on their waist for the 7 days following the visit.[26] Only counts from the vertical axis were used from the DPPOS accelerometers, as this is the only axis measured by both the uniaxial and triaxial monitors used in