Accurate and reliable assessment of physical activity remains an important challenge for epidemiologists, exercise scientists, clinicians, and behavioral researchers. The desire to explain and stem the dramatic increase in overweight and obesity prevalence observed among youths and adults has focused attention on the need for better measures of physical activity. These measures fall into three general categories: direct observation, subjective reports, and portable monitors, such as accelerometers. These monitors measure body movement in terms of acceleration, which can then be used to estimate physical activity intensity. As recently as 1999, accelerometry was still considered to be in the developmental stage. In October of that year, the Cooper Institute hosted a meeting titled “Measurement of Physical Activity.” One of the conclusions from the meeting was that objective motion sensors were not practical for large-scale studies because of high cost, uncertain reliability, and difficulties in the interpretation of data (1).

Since then, the scientific community has responded vigorously to the need for improvements in this field with technological developments and novel applications of existing and new technology. The published scientific literature provides a demonstration of the magnitude of this response. Figure 1 shows the trend in scientific articles related to accelerometry. The data were obtained by searching the Scopus bibliographic database (www.scopus.org, accessed on June 23, 2005) for original research articles or reviews that included the terms “accelerometer or accelerometry” and “physical activity” in the title, key words, or abstract. Between 1981 and 1996, it was rare to find more than 10 articles per year. From 1997 on, the increase was dramatic, with almost 90 articles per year in 2003 and 2004. These articles encompass reports on accelerometer device development, calibration and validation studies, and behavioral research studies that use the devices. These data suggest that accelerometry technology and its applications have progressed significantly.

Although much of the growth in accelerometry use involves research applications, investigators also have begun to explore the use of the devices in population surveillance. As this supplement goes to press, objectively measured physical activity data from the 2003–2004 cycle of the National Health and Nutrition Examination Survey (NHANES) are about to be released for public access by researchers. These data were collected on approximately 7000 survey participants ages 6 yr and older who were asked to wear an accelerometer during their waking hours for seven consecutive days. The collection of accelerometry data in NHANES represents the largest implementation of objective physical activity monitoring to date.

Despite evidence of increasing use of objective methods of physical activity assessment, further development is still needed. Reliable accelerometer devices are available, but their costs are still high (though not prohibitive). In addition, interpretation of the resulting data remains a challenge because of gaps and inconsistencies in the calibration and validation literature and unresolved issues of statistical analysis of the large quantity of data produced by accelerometers.

These remaining gaps are the focus of papers in this supplement, which represents the culmination of a process that began in 2003. In December of that year, Dr. Dianne Ward, Professor and Director of the Intervention and Policy Division, Department of Nutrition at the University of North Carolina, proposed a conference to address questions that researchers encounter in their attempts to monitor physical activity using accelerometers. Support for the conference was provided to the University of North Carolina by Get Kids in Action, a partnership between the University and the Gatorade Company. The National Cancer Institute funded publication of the proceedings. A committee, which included Drs. Oded Bar-Or, Diane Catellier, Kong Chen, Kelly Evenson, Patty Freedson, Janet Fulton, Charles Matthews, Robert McMurray, Richard Troiano, and Stewart Trost was constituted to plan the conference. The committee agreed that the meeting should have the following objectives:

- Bring together experts in objective physical activity assessment to examine gaps in the knowledge on the use of accelerometers to assess physical activity.
- Address questions related to the implementation of accelerometers in research studies, such as the number
of days required to represent a person’s activity, the number of hours needed to represent a valid day, and appropriate length of accelerometer epochs to use.

- Propose optimal methods of data analysis that address such issues as handling missing data, producing summary measures, and minimizing bias due to incomplete data.
- Present monitor calibration data for adults and children that could assist in establishing cut points for moderate and vigorous intensity and measuring sedentary behavior.
- Explore emerging technology for physical activity assessment, including integration of physiologic, biomechanical, and geographic information system (GIS) technology.

The conference, “Objective Measurement of Physical Activity: Closing the Gaps in the Science of Accelerometry,” took place at the University of North Carolina on December 13–15, 2004. The conference was organized around topic areas of implementation of objective monitoring, data analysis issues, calibration studies, and new technologies for assessing physical activity. Following each paper, a discussant who had reviewed the paper before the meeting provided expert commentary. Approximately 60 invited participants, including key researchers in the development and use of accelerometer, heard and responded to presentations by the authors and discussants.

The presentations were:

- Implementation in the Field, presented by Stewart Trost and discussed by Russ Pate
- Imputation of Missing Data When Measuring Physical Activity by Accelerometry, presented by Diane Catelier and discussed by Matthew Mahar
- Summarizing Accelerometer Data: A Comparison of Different Algorithms, presented by Louise Masse and discussed by Margarita Treuth
- Conducting Calibration Studies, presented by Gregory Welk and discussed by John Reilly
- Integration of Physiological and Accelerometer Data to Improve Physical Activity Assessment, presented by Scott Strath and discussed by Ulf Ekelund
- Calibration of Accelerometer Output for Adults, presented by Charles Matthews and discussed by Klaas Westerterp
- Calibration of Accelerometer Output for Children, presented by Patty Freedson and discussed by Kathleen Janz
- Understanding the Current and Emerging Technologies, presented by Kong Chen and discussed by David Bassett
- Use of Global Positioning Systems to Complement Accelerometer-Based Physical Activity Monitors, presented by Daniel Rodriguez and discussed by Philip Troped

In addition to the presented papers, 10 posters were selected for presentation under the themes of New Methodologies for Calibration and Summarization of Accelerometry Data or New Technologies for Physical Activity Assessment. Most of the abstracts are printed in the supplement. The comments of the discussants, session moderators, and meeting attendees were recorded and transcribed. These comments have been integrated by the authors of the papers in this supplement and included in the paper “Accelerometer Use in Physical Activity: Best Practices and Research Recommendations.”

The conference presenters and participants could not provide a best practices answer to all the questions that researchers face when planning to monitor physical activity. In some areas, such as practical guidance for implementation of accelerometers in research studies, significant agreement exists and the suggestions provided in individual papers are “ready for prime time,” providing valuable procedures for researchers interested in using accelerometry. In other areas, such as decisions related to data analysis and cut points for classification of activity intensity, neither the available science nor the experts are ready for a consensus decision. These issues are noted in the individual papers and described as future research needs in the summary paper.

In addition to recognizing the inability to resolve certain questions for researchers, it must be noted that the presen-
tations in this meeting concentrated on the use of the ActiGraph accelerometer, a device that has been used in the majority of accelerometer research studies and for which many validation studies are available. Not only are other manufacturers continuing to develop new devices for physical activity assessment, but the ActiGraph has just converted from piezoelectric to digital sensor technology. Although the manufacturer’s stated intent is to maintain data consistency with the previous technology, such comparability remains to be demonstrated.

The observations and data compiled in this supplement will be extremely valuable for researchers seeking to use accelerometers for physical activity assessment. As noted in the summary paper, continued methods research on validation, calibration, and statistical approaches to handling the complex data provided by accelerometers are needed. Both the answers and the questions collected in these reviews will improve the assessment of physical activity through objective measures, and thereby promote increased understanding of the link between physical activity and health.

The conference and the supplement itself benefited greatly from the work of two important individuals. Anne Rodgers, consultant for the National Cancer Institute, joined Dianne Ward as coeditor for the supplement. Anne reviewed all papers, presentations, and transcribed discussion sections to provide invaluable guidance and leadership to this project. All the excellent conference arrangements and communications were handled by Amber Vaughn, UNC research coordinator. Without Anne and Amber, this work would not have been possible.

**REFERENCE**