

# Modeling daily and weekly moderate and vigorous physical activity using zero-inflated mixture Poisson distribution

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**Abstract:** Large epidemiological studies use recently developed accelerometer devices for continuous and objective monitoring of physical activity. Typically, physical movements are collected in 1-minute epochs and a participant's daily counts of minutes spent in light, moderate and vigorous physical activities are calculated. Because of preponderance of zeros, the daily moderate or higher levels of physical activity data have been modeled using zero-inflated distributions. However, these models do not fully account for variations in daily physical activity and cannot be extended to model weekly physical activity explicitly; while weekly physical activity is often used as an indication of a person's average level. To overcome these limitations, we propose to use a zero-inflated Poisson mixture model for daily physical activity, allowing simultaneous assessments of covariates on daily as well as weekly physical activity. Specifically, a latent variable indicating the likelihood of an active day and the amount of exercise given an active day are modeled respectively by a joint random effects model that incorporates heterogeneity across participants and if needed by an additional random effect to address extra variations in daily physical activity. Maximum likelihood estimation are carried out through Gaussian quadrature technique, which is implemented conveniently in an R package GLMM adaptive. The performance of the methods is examined using simulation studies. These methods are applied to data from the Hispanic Community Health Study/Study of Latinos to examine the difference in daily physical activity between weekday and weekend and the difference in daily and weekly physical activity between BMI groups.