



Maintenance of physical activity: Do we know what we are talking about?

Daniela Kahlert*

Exercise and Health-Science, Department of Sport and Exercise Science, University of Stuttgart, Nobelstr. 15, Stuttgart 70569, Germany

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ABSTRACT

Objective. Physical activity has to be performed regularly in order to achieve long-term health benefits. Studying the maintenance of physical activity and comparing study results requires a shared descriptive definition and a derived operationalization. Both are still lacking. The goal of this article is to briefly summarize how "maintenance of physical activity" is used in the scientific literature. Further, a descriptive definition and its operational application are introduced.

Method. A rapid literature search was completed in order to summarize the different concepts and usages of the term "maintenance of physical activity."

Results. "Maintenance of physical activity" is used and defined in different ways. All of them have strengths and weaknesses. An approach that respects the volatility of physical activity is lacking. That's why the lapse–recovery relationship is introduced.

Conclusion. People's physical activity volume is often volatile, which is crucial for defining and assessing "maintenance of physical activity". The lapse–recovery relationship is an individual-centered approach respecting this volatility. It refers to an intentionally changed behavior and uses lapses and recoveries as indicators to operationalize the maintenance of physical activity.

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Introduction

There is extensive evidence that physical activity reduces the risk of non-communicable diseases and promotes health (Powell et al., 2011). Long-term health effects are most often the result of regular and sustained activity (Marcus et al., 2000). Many studies address either the prevalence of activity of different people and groups or the predictors of the maintenance of physical activity (Amireault et al., 2013; Van Stralen et al., 2009).

However, conducting research and comparing study results requires a common sense of "maintenance of physical activity." Conceptual problems in defining maintenance were addressed long ago (Dishman, 1982). A shared descriptive and a derived operational definition of the maintenance of physical activity are still lacking. This affects how this topic is studied. That's what former (Dishman, 1982; Oldbridge, 1982) and current reviews have criticized (Amireault et al., 2013; Nigg et al., 2008).

The goal of this commentary is to briefly summarize the different usages of the term "maintenance of physical activity" and to discuss the

corresponding implications. Finally, a descriptive definition of "maintenance of physical activity" and its operational application is introduced.

Phenomenon and common usage of the term "maintenance of physical activity"

What could typically be observed when people intend to engage in physical activity above their current habitual level? After starting to increase their physical activity and becoming more or less regularly active, most people become less active again and drop back to their former physical activity patterns and volumes. This could be described as a "relapse." Other people are more successful. They stick to that behavior for a longer period and their increased volume of physical activity becomes habitual. This pattern of behavior could be classified as "maintenance."

On closer examination, the two patterns—"relapse" and "maintenance"—are not sufficient to address the whole phenomenon. In a given period, the volume of physical activity is most often *volatile*. Some people drop back to their former behavior for some days or weeks but then resume a higher activity level again. This pattern could be classified as a "lapse" instead of a "relapse." Hence, "maintenance of physical activity" can be described as the repetition of being active over a period of time—even if or in spite lapses occur.

Up to now, the maintenance of physical activity is measured in different ways. Observational studies ask participants at least at two

* Fax: +49 711 685 63165.

E-mail address: daniela.kahlert@inspo.uni-stuttgart.de.

measurement points, often 6 months between each, if they achieve a pre-defined behavior (e.g., accumulating 150 min of moderate physical activity per week). If they do so, they are ascribed as “successful maintainers” (Rhodes et al., 2008). The usage in these observational studies is different compared to other areas of health behavior where maintenance refers to the goal that is addressed by a behavioral change (Marcus et al., 2000). A “maintainer” is, for instance, a former smoker who has become a non-smoker.

Another approach is often used within intervention studies where two or more groups are compared in a repeated measurement design. In this approach maintenance indicates a statistical difference in the behavior at the measurement points in comparison to another group (Fjeldsoe et al., 2011). Such a description refers to maintenance as a success term. However, the assessment of group means provide only limited information about one's individual behavior.

Assessing the volume of physical activity only a few times in a repeated measurement design, as described in these first approaches, underates the impact of volatility of physical activity (Wagner, 2007). Going beyond that, there are also studies using shorter time periods between the assessment points (e.g., 1 week). In addition to describing how many people experience a lapse over time (Simkin and Gross, 1994), it is possible to analyze how long it lasts until the first lapse occurs (Armitage, 2005). Still, “lapses” are only one crucial element of assessing maintenance.

Frequencies of physical activities or their distribution over a given period are also used as indicators to categorize subjects' behavior as “maintain,” “relapse,” “adopt,” or “remain inactive” (Williams et al., 2008). Such a categorical approach provides qualitative information about the behavior, but it restricts the statistical analysis due to lower levels of measurement.

“Moving averages” are a special kind of filter used to analyze a set of data points in time series analyses (Fuchs et al., 2005). Based on the “raw data” and moving averages, an explorative cluster analysis is used to detect the behavioral patterns in the data. The cluster solutions are then inspected either by discriminant analysis or by cross-validation procedures to classify subjects to their cluster. According to visual impressions of the patterns detected, clusters have been described as “maintainers,” “fluctuators,” “early dropouts,” and “late dropouts” (Fuchs et al., 2005). These patterns are based on the subject's behavior and respect the volatility of physical activity, but the behavioral patterns detected in a given sample “belong” to that study sample. Another sample would affect the group assignment of a person and the cluster definitions entirely.

This short overview of the usage of “maintenance of physical activity” demonstrates the variation with which it has been operationalized in studies thus far. Aiming to overcome the limitations presented, the Health Maintenance Consortium (HMC) published a definition of maintenance and related constructs in its lexicon for measuring behavior change (Seymour et al., 2010). *Maintenance* is defined as a continued behavior shown during a given period and after an intervention complying with a threshold believed to improve well-being or health. The HMC also defines *grace periods*, in which a lack of adoption is not classified as a failure, *relapse* as a period of interruption of the regular behavior after the initiation, and *re-activation* as the resumption after a period of relapse (Seymour et al., 2010). The HMC definitions are helpful, although the question of how maintenance of physical activity should be assessed is not answered.

An additional approach: lapse–recovery relationship

Based on the HMC (Seymour et al., 2010) and the fact that physical activity is a volatile behavior, an individual-centered description is suggested here. This approach is linked to a *personal goal*. Based on the evidence that even small amounts of physical activity are beneficial for health (Powell et al., 2011), such an individual goal may differ from current recommendations (e.g., Health Enhancing Physical Activity

recommendation). This *goal* should define a *progression of volume* and refers to an *intended change of that volume*.

For example, person A is currently engaging in 20 min of moderate physical activity per week. She intends to increase this volume to 30 min of moderate intensity per week. The increased volume of physical activity is a *personal goal*. If the person fails to reach their goal, this would be defined as a “lapse.” A “recovery” describes whether a person re-establishes the individual goal after a lapse. Lapses as well as recoveries could be assessed by asking people to define their intended physical activity volume and whether they were successful or failed to reach that goal in the last week, for instance. If one fails, this would be counted as a lapse. As soon as one attains the intended physical activity volume again, this would be counted as a recovery. The volume of physical activity could also be assessed by objective assessments, such as accelerometers, and compared with the intended physical activity volume.

The number of lapses and recoveries from those lapses during a period are indicators of maintenance of physical activity. Both should be valued in relation to each other; otherwise, misinterpretations could occur. For instance, persons A and B take part in a 26-week physical activity program aiming to enhance their physical activity. Person A experienced 2 lapses and 2 recoveries. Person B was faced with 4 lapses and showed 3 recoveries. Regarding only the recoveries, person B is more successful than person A. Valuing both shows that person A is the one who remains physically active, because person B showed one recovery fewer than the number of lapses occurred.

The advantages of this approach are as follows: First, lapses and recoveries stem from individual data. The lapse–recovery relationship describes the behavior of a given person but could also be analyzed on a group level without depending on other person's physical activity patterns (i.e., the study sample). Second, all variables are continuous, which allows for more complex statistical analysis than lower measurement levels do. Third, the lapse–recovery relationship respects the usage of maintenance as a “success term” (Marcus et al., 2000). It is based on an individual goal, an intended behavior change and it provides information if one has failed to reach that goal. Lastly, this way of describing and analyzing maintenance of physical activity respects one's physical activity level and goal and is therefore appropriate for tailored interventions. It would eliminate the issue of different “gaps” (due to different starting levels) to achieve prescribed physical activity levels, which in turn could affect the success rates.

This approach requires some effort that may exceed the capacities of large observational studies. However, it could be worthwhile to discuss the appropriate usage of the term “maintenance of physical activity” in observational studies. According to comparable approaches in the behavioral sciences (Marcus et al., 2000), “maintenance of physical activity” should be used when there is behavior to maintain. In this sense, large observational studies tracking the prevalence of physical activity are not actually measuring its maintenance. The volatility of physical activity should mainly be considered in intervention studies aiming to increase people's physical activity volume. The lapse–recovery relationship might be a possible approach.

Conclusion

In order to account for the inter-individual differences and the intraindividual volatility, it is suggested to reconsider how the term “maintenance of physical activity” is used and studied.

List of abbreviations

HMC: Health Maintenance Consortium

Conflict of interest

The author declares she has no conflict of interests.

Authors' contributions

Not applicable.

Author information

DK is a post-doc researcher at the Department of Sport and Exercise Science, Faculty of Economic and Social Science, University of Stuttgart, Stuttgart, Germany. Her research interests are (socio-ecological) determinants of health behavior, behavior modification, maintenance of physical activity as well as the relation between the built environment, social participation, and physical activity of older people.

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