Increasing Physical Activity with Mobile Devices

A Meta-Analysis

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Background

• Physical activity (PA) is associated with reduced morbidity and mortality

• Despite endeavors to enhance participation, reduce attrition, and increase maintenance, PA rates remain low

• New consumer technologies offer a potential solution to these problems
The Mobile Device

• The Mobile Phone
  • Devices capable of communicating via voice and text

• Personal Digital Assistant (PDA)
  • Examples: Palm Pilot, Dell Axim
  • Offer organizational, basic word processing, internet, and entertainment features

• Smartphone
  • Combined PDA features with those of a mobile phone
  • Originally popular among businessmen, popularized by the 2007 release of the Apple iPhone
The Mobile Device

• Integrated into daily functioning for many individuals
• High levels of usage across demographic groups
  • 4 in 5 adults own mobile phones
  • 95% of young adults use mobile phones
  • In many western countries, mobile phones outnumber citizens
• An evolving technology
  • Many new features become less expensive and more widely used with time
Mobile Devices and Health

- Meta-analysis of mobile phone use for glucose control (Liang et. al., 2011)
  - 21 publications (n=1,657)
  - Overall reduction in HbA$_{1c}$ ($p<.001$)
- Systematic review and meta-analysis of the effect of internet-based interventions on health-related behavior (Webb et. al., 2010)
  - 85 studies targeting health behavior (n=43,236)
    - $d = 0.16$
    - 20 studies targeted physical activity
      - $d = 0.24$
- Lack of review or meta-analysis addressing physical activity behavior change with a mobile device
Purpose

• Conduct a review and meta-analysis in order to:
  1. Determine the efficacy of mobile devices in previous physical activity research
  2. Examine common features of mobile devices in the research context
  3. Develop recommendations for future use
Methods

• Extensive Search through February, 2012
  • Online databases
  • Reference lists
  • Direct requests to experts

• Inclusion Criteria:
  • Implementation of mobile technologies
  • Target physical activity
  • Provide original data
Methods

• Quality assessed via the *Guide to Community Preventative Services* data extraction form
  • Concerned with “threats to validity”
    • Good – 0 - 1 limitations
    • Fair – 2 - 4 limitations
    • Poor – 4+ limitations

• Note – no “gold-standard”
Analysis

• Extracted:
  • Means (M)
  • Standard Deviation (SD)

• Calculated: Cohen’s $d$

• Software: *Comprehensive Meta-Analysis*
  • *(Borenstein & Rothstein, 1999)*
Intervention Characteristics

- 9 Unique Studies (n=743)
  - 7: Mobile Phone
  - 6: SMS
  - 3: Native Application
  - 2: PDA
Characteristics

• Reported Outcomes
  • MVPA duration
  • MVPA frequency
  • % Active time spent in MVPA
  • Pedometer step counts
  • Number of days of exercise per week
  • Days per week walking for exercise
## Results

| Study Authors | N   | Duration (weeks) | Effect |
|---------------|-----|------------------|--------|
| Conroy        | 198 | 24               | -.075  |
| Fjeldsoe      | 88  | 12               | .548   |
| Fukuoka       | 82  | 3                | .311   |
| Hurling       | 77  | 9                | -.076  |
| King          | 37  | 8                | 1.517  |
| Nguyen        | 17  | 24               | .788   |
| Prestwich     | 134 | 4                | .699   |
| Shapiro       | 40  | 8                | .501   |
| Sirriyeh      | 118 | 2                | .201   |
## Results – Outcome Measures

| Outcome               | n  | g    | Q                  | $I^2$ |
|-----------------------|----|------|--------------------|------|
| Overall PA            | 9  | .4170| 26.92 (df=8, $p=.0007$) | 70.28|
| MVPA Duration         | 4  | .3395| 14.31 (df=3, $p=.0025$) | 79.04|
| Steps                 | 2  | .3498| 0.1826 (df=1, $p=.6691$) | 0    |
Results – Components

| Component       | n | g   | Q               | I²  |
|-----------------|---|-----|-----------------|-----|
| Mobile Phone    | 7 | .3905 | 8.85 (df=6, p=.1823) | 32.20 |
| SMS             | 6 | .4064 | 8.6776 (df=5, p=.1226) | 42.38 |
| Native Apps     | 3 | .5078 | 15.91 (df=2, p=.0004)  | 87.43 |
| PDA             | 2 | .6826 | 15.43 (df=1, p=.0001)  | 93.52 |
Results

• Quality:
  • Three studies of “good” quality
  • Five studies of “fair” quality
  • One study of “poor” quality
Discussion

• Results indicate that the mobile platform is effective for increasing physical activity behavior.

• There is significant heterogeneity among studies.

• Understanding common design issues is an important first step when considering design of future interventions.
Discussion: Design Characteristics

• The role of SMS
  • Supplement data collection
  • An alternate means of communication
  • May assess behavior in real time
  • Must be recognized as one of many tools

• Lacking Automation
  • The mobile environment is flexible and conducive to immersive tailoring and automation

• Theoretical frameworks must be adapted and developed which assess unique aspects of the mobile platform
Discussion: Native Applications

- Popularity of widespread app development is a unique and key feature to mobile devices
  - Reside on the device
  - More complex, more flexible than web applications
  - Reach a diverse population
- Previous work has been successful
  - Interesting examples
    - UbiFit (Consolvo, 2008)
    - Neat-o-Games (Fujuki, 2008)
Discussion: Ubiquity

• Most important advantage of mobile devices
  • Availability of diverse applications have led many to integrate their mobile device into their daily lives.
  • We can deliver materials and collect data with little additional burden

• Components which might hinder the usability for the participant should be minimized
Conclusion

• This research indicates that mobile devices are effective in increasing physical activity behavior.
• Much of the potential of the device is unexplored in the research setting.
  • Integral in daily functioning
  • Exchange rich multimedia information
  • Collection of data and distribution of materials in real time
• There is significant heterogeneity in study design and outcomes measured
• Future researchers must address new, popular technologies in a methodical, theoretically grounded fashion.
Thank You