

Development and feasibility of mHAT: a smartphone app to improve awareness of hypoglycemia

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Background

- ‘Mobile Hypo Awareness Training’ (mHAT) is a smartphone application (app) designed to raise awareness of hypoglycemic symptoms/cues
- mHAT will be one part of an online psycho-behavioural intervention to prevent severe hypoglycemia in adults with type 1 diabetes
- mHAT is based on the paper diary of Blood Glucose Awareness Training (BGAT), an evidence-based psycho-behavioural intervention to improve hypoglycemic awareness (1)

Aim

- To test the acceptability and feasibility of mHAT version 1 (v1) in adults with type 1 diabetes

mHAT version 1

- Before each routine blood glucose (BG) check, users are invited to:
 1. reflect on external cues (activity, food/drink, insulin)
 2. identify hypoglycemic symptoms
 3. record their estimate of their BG level
 4. check and record their actual BG level
- After working through all 4 steps, 3 summary screens are generated:
 1. list of identified cues/symptoms
 2. graph with last estimated/actual BG level
 3. summary graph with all estimated/actual BG levels



References

1. Cox D, Gonder-Frederick L, Polonsky W, et al. *Diabetes Care*, 1995; 4: 523-8
2. Little S, Chadwick T, Choudhary P, et al. *BMC Endocrine Disorders*, 2012; 33

Methods

Study design

The study was approved by Deakin Human Research Ethics Committee and all participants provided informed consent

1. User acceptance testing:
 - 6 adults worked through the mHAT demonstration version in the presence of researchers and their feedback was incorporated into the fully functional mHAT v1
2. Feasibility testing:
 - Eligibility: Adults (18+ years) with type 1 diabetes, residing in Australia with access to a smartphone and internet
 - Recruitment was via Twitter/Facebook from Nov 2016 to Jan 2017
 - Participants completed questionnaires (Qualtrics™), read information about hypoglycemia (2), watched an instruction video, and had access to app over a 3-week period
 - After 3 weeks, participants provided feedback via online questionnaires
3. Interviews were conducted with participants, purposely selected for (high/low) frequency of mHAT use during the 3 weeks

Results

Participant characteristics

	Feasibility Study (N=24)	Interviews (N=10)
Age, years	41 (18-67)	50 (30-67)
Gender: female	15 (63)	6 (60)
University degree	10 (42)	6 (60)
Living alone	2 (8)	1 (10)
Type 1 diabetes duration, years	13 (<1-39)	18.5 (<1-39)
Insulin pump use	13 (54)	4 (40)
Impaired awareness of hypoglycemia: Gold ≥4	7 (29)	2 (20)
Any hypo in past week	3 (0-12)	2.5 (1-12)
Severe hypoglycemia in past 6 months: Yes	10 (42)	2 (20)
HFS –II Worry score	17.5 (1-50)	17.5 (1-32)

Data are median (min-max) or N (%)

Conclusions

- As an alternative to a traditional paper diary, an ‘app’ has significant benefits for the end user in terms of convenience, direct and automated feedback
- Transferring content to a mobile platform was challenging: e.g. keeping the right balance between an app that is ‘quick and easy’ to use (i.e. reduce burden) and relevant/useful content (e.g. symptoms and cues, feedback)
- mHAT was acceptable and feasible to users, and they offered constructive feedback, though many had not experienced problematic hypoglycemia
- Suggestions for mHAT v2 were identified:
 - Improve graph with more feedback on accuracy, relation between cues/symptoms and accurate BG estimations, trends
 - Enable retrospective use, e.g. after managing hypoglycemia
 - Enable offline use and consider integration with other diabetes apps
- Future directions: We plan to develop mHAT v2 and test it in a large group of adults with impaired awareness of hypoglycemia and history of severe hypoglycemia

Results

App use

- 24 participants used the app for 1-25 days, generating 576 valid datapoints
- 84 (15%) datapoints showed an actual BG in the hypoglycemic range (≥ 3.9 mmol/L), while 9 estimations of those were ≥ 8 mmol/L

User feedback

- 16/24 participants completed 3-week follow-up online questionnaires
- Overall, participants found mHAT ‘quick & easy’ to use (14/16)
- mHAT raised awareness (8/16): “made me think about how my body feels and raised my awareness of symptoms”; “helped me checking BG straight away when I was feeling funny”; “made me think about food and activities”
- Reasons for low use: no extra benefit/value compared to routine tools; another “thing” to do; use of other app/pump downloads

Adjustments to diabetes management (interview data, N=10)

- One participant reported treating hypoglycemia more promptly
- One reduced basal insulin rate (after consulting health professional); mHAT use had raised awareness of having more hypoglycemia than assumed
- Two participants changed their management to lower their BG; mHAT had raised their awareness of high BG levels

Limitations of study

- While sample sizes were reasonable for the feasibility and interview studies, most participants did not have problematic hypoglycemia and had intact awareness of their hypoglycemia. Thus, the perceived usefulness of mHAT may be different for people with impaired awareness or history of severe hypoglycemia
- In contrast to BGAT, mHAT v1 provided limited feedback about (un)reliable symptoms/cues of hypoglycemia; there was no feature linking perceived symptoms/cues to actual BG levels. This may explain some participants’ observations that mHAT did not provide additional value

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