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1 **Title:** Physical activity and sedentary behaviour among inpatient adults with mental illness

2

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24 **Title:** Physical activity and sedentary behaviour among inpatient adults with mental illness

25

26 **ABSTRACT**

27

28 **Objectives:** The aim of this study was to assess levels and patterns of physical activity and
29 sedentary behaviour among inpatient adults with mental illness.

30 **Design:** Cross-sectional

31 **Methods:** 101 participants completed questionnaires on time spent in walking, moderate-
32 and vigorous- intensity activity in the past week and domain specific sitting time on a usual
33 weekday and weekend day. 36 participants also provided valid accelerometry data.

34 Regression analyses were used to explore associations between MVPA and sedentary
35 behaviour and explanatory variables of gender, age, education, body mass index and
36 psychological distress.

37 **Results:** Self-report data indicated median of 32 minutes/day (IQR: 14.46–85.71) in
38 weighted MVPA and a median of 761 minutes/day (12.7 hours) (IQR: 552.43–917.14) in
39 sedentary behaviour. Accelerometry data indicated an average of 115 minutes/day in light
40 activity, 37 minutes/day in MVPA and 664 minutes/day (11.1 hours) in sedentary behaviour.
41 Bivariate analyses indicated no significant associations between explanatory variables and
42 MVPA and sedentary behaviour.

43 **Conclusions:** Inpatient adults with mental illness can be physically active, with walking
44 comprising the major component of MVPA time. Inpatient adults with mental illness spend a
45 significant amount of time sitting; intervention strategies could focus on reducing the time
46 spent sitting in general relaxation and doing nothing.

47

48 **Keywords:** Mental health, physical activity, sedentary behaviour, accelerometers

49

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51

51

52 **INTRODUCTION**

53 The life expectancy of adults with mental illness is worse than that of the general population
54 and is largely due to poor physical health status^{1,2} including obesity, type two diabetes
55 mellitus, hypertension, dyslipidemia and cardiovascular disease^{3,4}. Low levels of physical
56 activity^{5,6} and high levels of sedentary behaviour^{7,8} may contribute to these poor health
57 outcomes and reduced life expectancy².

58

59 Studies on physical activity and sedentary behaviour of adults with mental illness have
60 predominantly been carried out in community settings⁹⁻¹¹ or subsumed in population-based
61 surveys¹². One Australian survey reported that 64.5% of a sample of 1,825 people with
62 psychoses were active¹², and another reported that 49% of 150 adults with schizophrenia
63 achieved >150 minutes of physical activity, with 44% of these achieving at least five
64 sessions¹¹. However, data from the 2007-2008 Health Survey of Australia indicated that
65 adults who had high or very high levels of psychological distress were less likely to achieve
66 at least 150 minutes/week of moderate intensity activity than those with lower levels of
67 distress¹³. Accelerometer data from 60 outpatient adults with bipolar disorder found that
68 participants averaged 14 minutes per day in moderate-vigorous physical activity (MVPA) and
69 13.5 hours/day in sedentary behaviour¹⁰. Another study concluded that 35% of 55
70 overweight/obese adults with severe mental illness did \geq 150 minutes/week of MVPA, and
71 the average time spent in MVPA was 120 minutes/week¹⁴. Studies of adults with mental
72 illness suggest lower rates of activity among females, and those with low education and high
73 BMI^{9,15,16}; and higher rates of sedentary behaviour among those with high BMI¹⁷.

74

75 Little research has purposively assessed physical activity and sedentary behaviour patterns
76 among *inpatient* adults with mental illness. The inpatient experience may influence
77 behaviour due to e.g. the impact of the hospital environment and a change in competing
78 time demands. Time spent in hospital is an opportunity to establish adaptive self-

79 management practices that can then be continued out of hospital. To inform hospital-based
80 interventions, we need to understand levels and patterns of behaviour. The aim of this study
81 therefore, was to assess levels and patterns of physical activity and sedentary behaviour
82 among inpatient adults with mental illness.

83

84

85 **METHODS**

86 This was a cross-sectional study. Participants were inpatient adults (18-75 years; N=101)
87 with mental illness recruited in two waves over an eight-month period from a private
88 psychiatric hospital in Brisbane, Australia. The hospital's daily inpatient census was
89 reviewed weekly by the lead author and the charge nurse to exclude patients who did not
90 meet the following eligibility criteria: (i) psychiatric diagnosis as defined by the Diagnostic
91 and Statistical Manual of Mental Disorders, 5th Edition; (ii) not experiencing acute psychiatric
92 symptoms; (iii) not acutely suicidal; (iv) not under an involuntary treatment order. Eligible
93 patients were verbally invited to participate at least five days after admission, to allow time to
94 settle into the hospital. Ethical clearance was awarded by The University of Queensland
95 Human Research Ethics Committee (2014000420).

96

97 Self-reported physical activity was assessed using a modified version of the Active Australia
98 survey¹⁸. Items assessed the frequency of and total time spent walking for transport, walking
99 for recreation and leisure, and in moderate and vigorous intensity activity during the previous
100 week. The Active Australia survey has been used in National and state surveys^{18,19} and has
101 acceptable psychometric data with reliability coefficients ranging from 0.56-0.64 for each
102 domain of activity²⁰.

103

104 Self-reported sedentary behaviour was assessed using a modified version of a questionnaire
105 which asks about time spent sitting on each of a usual weekday and weekend day in (i)
106 travelling to and from places, (ii) at work, (iii) watching television, (iv) using a computer and

107 (v) leisure time²¹. The questionnaire has high reliability for weekday sitting at work, watching
108 television and using a computer ($r = 0.84-0.78$), but lower reliability for weekend days across
109 all domains ($r = 0.23-0.74$). To reflect the inpatient setting, leisure time was replaced with
110 general relaxing and five additional domains were added: (i) psycho-education group, (ii) art
111 therapy group, (iii) with a health professional, (iv) smoking and (v) doing nothing.

112

113 Objective physical activity and sedentary behaviour were assessed using Actigraph GT3x+
114 accelerometers. Participants wore the accelerometer positioned on the right hip on a belt
115 around the waist for 24 hours/day for seven consecutive days, and record in an activity diary
116 the times (i) they got out of bed in the morning and went to bed at night and (ii) anytime they
117 took off the accelerometer and the time they put it back on.

118

119 The Kessler (K6) scale²² was used to assess psychological distress. It has been shown to
120 have good reliability²³ and validity²². Responses were summed across items, which used a
121 five point Likert scale. A score of 6–18 indicated low to moderate psychological distress and
122 19–30 high psychological distress²².

123

124 Sociodemographic variables were assessed using standard questionnaire items. Variables
125 included gender, age, household composition, employment status and education. Data on
126 weight and height (used to derive body mass index) and diagnosis were retrieved from
127 participants' medical records. As participants could be assigned multiple diagnoses, each
128 diagnosis was recorded.

129

130 Self-reported physical activity data were included in the analysis if duration was available for
131 at least one questionnaire item. To avoid potential over-reporting, reported times greater
132 than 840 minutes (14hrs/week) for a single activity type were truncated at 840 minutes¹⁸.

133 Total self-report MVPA was calculated in weighted minutes/week by adding time in walking
134 for transport, walking for recreation and exercise, moderate- and vigorous- intensity activity,

135 with vigorous activity weighted by two to allow for its greater intensity. To further avoid
136 potential over-reporting, total MVPA times that were recorded as greater than 1680 minutes
137 (28 hours/week) were truncated at 1680 minutes¹⁸.

138

139 Self-reported sedentary behaviour data were included in the analysis if reported duration
140 was available for at least one questionnaire item. Based on the authors' knowledge of the
141 hospital routine, times were truncated to 12 hours/day for doing nothing; 10 hours/day for
142 each of time spent watching television, using a computer, smoking and relaxing; 5 hours/day
143 for each of art therapy groups and with a health professional and 3 hours/day for psycho-
144 education groups. Total daily sedentary behaviour was derived by summing times across the
145 10 domains and to further avoid potential over-reporting, times greater than 1020 minutes
146 (17 hours/day) were truncated to 1020 minutes/day. Average daily sedentary behaviour was
147 calculated by multiplying the weekday sitting total by five and the weekend sitting total by
148 two, then adding the two sums together and dividing by seven.

149

150 Actigraph software was used to analyse the data retrieved from the GT3x+ accelerometers.
151 Participants' day hours were defined by self-reported time out of bed in the morning and time
152 to bed at night. Data were considered valid if the monitor was worn for at least 10 day
153 hours/day²⁴ on four days of the week, including at least one weekend day²⁵. Accelerometer
154 non-wear time was identified from participants' activity diaries and from consecutive zero
155 counts for 60 minutes or longer. The cut-point criteria used were 0–99 counts per minute for
156 sedentary activity, 100–2019 for light activity, 2020–5998 for moderate activity and 5999 or
157 greater for vigorous activity²⁶. Moderate and vigorous activity were combined and time spent
158 in sedentary, light and MVPA were calculated as average minutes/day.

159

160 Five explanatory variables were considered to identify potential correlates of self-reported
161 MVPA and sedentary behaviour, including: gender and education (categorical measures);
162 and age, body mass index and psychological distress (continuous measures). Linear

163 regression was used to assess bivariate associations between MVPA/sedentary behaviour
164 and each of the five explanatory variables. Variables found to be associated at $p < 0.10$ at the
165 bivariate level were to be considered for multivariable analysis. Analyses were conducted
166 using SPSS version 22.

167

168

169 **RESULTS**

170 During the recruitment, 276 patients were eligible for this study. Of these, 99 (36%) could not
171 be contacted due to e.g. appointments with health professionals or being on leave from the
172 hospital. This resulted in 177 (64%) patients being invited to participate. Of those invited,
173 118 (67%) consented to participate in the survey and 101 (57%) provided data; and 50
174 (28%) consented to participate in the accelerometry and 38 (21%) provided data, with 36
175 (95%) meeting the accelerometer wear time criteria²⁴. Reasons for survey non-completion
176 included early discharge from the hospital ($n=10$) and poor mental health ($n=6$). One
177 participant lost the survey and declined to complete another. Reasons for accelerometry
178 non-completion included poor mental health ($n=5$), early discharge from hospital ($n=4$) and
179 forgetting to wear the accelerometer ($n=3$).

180

181 For self report activity data, scores were truncated for 3 (3%) of the participants, with
182 extreme values identified for walking for transport ($n=1$) and vigorous intensity activity ($n=2$).

183 For self-report sitting times, 6 (6%) participants gave no data as they found it too difficult,
184 and of those who provided data ($n=95$), scores were truncated for 26 (27%) participants. The
185 proportion of participants with extreme sitting time values was higher for attending psycho-
186 education groups (18%) than other domains ($<7\%$ each).

187

188 Participants' demographic characteristics are summarised in Table 1. The mean age was
189 40.7 years (SD 14.5) and 72% were female. The majority (61%) had a depressive disorder
190 and 68% had a high level of psychological distress.

191

192 Self-report data indicated a median of 32 weighted minutes/day (IQR: 14.46-85.71) in MVPA
193 and a median of 761 minutes/day (12.7 hours) (IQR: 552.43–917.14) in sedentary
194 behaviour. Accelerometry data indicated an average of 115 minutes/day in light activity, 37
195 minutes/day in MVPA and 664 minutes/day (11.1 hours) in sedentary behaviour.

196

197 Self-reported time spent in physical activity is summarised in Table 2. There was wide
198 variation in time spent walking with a median of 60 minutes/week in each of walking for
199 transport (IQR: 10.0–131.25) and walking for recreation and exercise (IQR: 0–150). Walking
200 accounted for the majority of physical activity sessions, with one quarter of participants
201 reporting five or more sessions/week of walking for transport, and about one third reported
202 five or more sessions/week of walking for recreation. Median values for moderate and
203 vigorous activity were zero. Approximately 75% of participants reported no sessions of
204 moderate-intensity activity, and approximately half reported no sessions of vigorous-intensity
205 activity. There was also wide variation in weighted MVPA time with a median of 225
206 minutes/week (IQR: 101.25–600). Overall, 65% of participants who provided self-report data
207 met guidelines of at least 150 minutes/week of MVPA²⁷.

208

209 Durations of self-reported sedentary behaviour are summarised in Table 4. The longest
210 reported sitting times were doing nothing on both weekdays (median 120 minutes/day, IQR:
211 60–240) and weekend days (median 120 minutes/day, IQR: 60–240), and with a health
212 professional (median 67.5 minutes/day, IQR 46.25–180) on a weekday. Data indicated a
213 median total time of 13 hours/day in sedentary behaviour on weekdays and 10 hours/day in
214 sedentary behaviour on weekend days.

215

216 Accelerometry results indicated that participants spent an average time of 11.2
217 hours/weekdays and 10.8 hours/weekend days in sedentary behaviour; 1.85

218 hours/weekdays and 2.1 hours/weekend days in light activity, and 38 minutes/weekdays and
219 34 minutes/weekend days in MVPA.

220

221 Bivariate analyses indicated no statistically significant associations between each of the
222 explanatory variables and self-report MVPA (gender: $\beta=-0.079$, $p=0.446$; education: $\beta=-$
223 0.050 , $p=0.632$; age: $\beta=0.019$, $p=0.856$; BMI: $\beta=-0.10$, $p=0.341$ and psychological distress:
224 $\beta=0.022$, $p=0.632$) or sedentary behaviour (gender: $\beta=-0.041$, $p=0.717$; education: $\beta=0.037$,
225 $p=0.748$; age: $\beta=0.073$, $p=0.523$; BMI: $\beta=0.088$, $p=0.445$ and psychological distress:
226 $\beta=0.059$, $p=0.607$). Multivariable analyses were therefore not conducted.

227

228

229 **DISCUSSION**

230 This study indicates that adult inpatients with mental illness can be physically active, with
231 65% meeting the Australian Physical Activity Guidelines of at least 150 minutes per week²⁷
232 and a median of self-reported MVPA of 32 minutes/day (IQR: 14.46–85.71). This self-
233 reported data was consistent with the accelerometry results, which indicated an average of
234 37 minutes/day in MVPA. Although our sample was predominantly comprised of people with
235 depression, these results are consistent with one previous Australian study of people with
236 psychosis living in the community which found that 65% were meeting guidelines¹².

237

238 Our findings however, contrast other research indicating that the majority of adults with
239 mental illness are not meeting activity guidelines^{10,11,14}. It may be that while in hospital,
240 inpatients are in a structured and supported environment and have had a change to
241 competing time demands, for example, work attendance. This would provide more
242 discretionary time for MVPA. As participants were voluntary admissions, they were able to
243 take leave, and it was observed that many people did so to walk to and around a nearby
244 shopping mall to have a break from the hospital. In our study, walking comprised the
245 majority of MVPA time, and few people engaged in other MVPA.

246

247 The results indicate that inpatient adults with mental illness have prolonged sitting time. Self-
248 report data indicated a median of 761 minutes/day (12.7 hours) (IQR: 552.43–917.14) in
249 sedentary behaviour, and accelerometry data indicated an average of 664 minutes/day (11.1
250 hours). These findings are similar to a previous accelerometry study of outpatient adults with
251 bipolar disorder that found an average of 13.5 hours/day in sedentary behaviour¹⁰. However,
252 another study of outpatient adults with schizophrenia spectrum disorders found an average
253 of 6.75 hours/day in sedentary behaviour²⁸. The different diagnoses of participants across
254 studies may contribute to these study differences.

255

256 More time was spent in sedentary behaviour on weekdays than weekend days. Self-report
257 data indicated a median time of 13 hours/weekdays and 10 hours/weekend days which was
258 consistent with accelerometry results of an average of ~11 hours/weekdays and ~10
259 hours/weekend days. This could in part be attributed to the time spent with health
260 professionals (median 67.5 minutes/day) and in psycho-education groups (median 60
261 minutes/day). Allied health professionals are more likely to work on weekdays and the
262 hospital facilitates psycho-education groups only on weekdays. Participants spent a median
263 of one hour on both weekdays and weekend days watching television. This is in contrast to
264 general population based studies in which watching television is a common context for
265 prolonged sedentary behaviour²⁹. For example, one general population study indicated the
266 average time spent watching television was 13 hours/week³⁰ which is almost double the time
267 in our study. The short time spent watching television in our study may reflect the specific
268 hospital setting; inpatients have limited access to television; and are obliged to either use a
269 shared area or pay to have access to a television.

270

271 The main area of concern for this population in relation to sedentary behaviour is the time
272 spent “doing nothing” on both weekdays and weekend days. While other hospitalized
273 patients with physical conditions may have movement restrictions, a psychiatric population is

274 typically ambulatory. There is a need therefore, to explore options for non-sedentary
275 activities on both weekdays and weekend days for inpatients with mental illness.

276

277 There were no significant associations between explanatory variables of gender, education,
278 age, BMI and psychological distress and MVPA and sedentary behaviour which contrasts
279 other studies conducted among adults with mental illness^{9,15-17}. This may reflect the inpatient
280 environment, however more work however is needed to confirm this finding.

281

282 Caution should be used in generalizing the results to all mental health inpatients. Our study
283 was conducted in one private psychiatric hospital, and the majority had depression as the
284 primary diagnosis. Different results may have been obtained with a different mix of
285 diagnoses, for example if there were more participants with schizophrenia. The study
286 sample was not random, not all eligible patients were invited to participate, and not all of
287 those who consented completed the assessment. There was a potential for response bias
288 as the recruitment relied on volunteers; patients who had no interest in activity, or those who
289 had worse mental health might not have been included. Patients who were unable to be
290 located due to leave from the hospital during recruitment were not included. In order to
291 minimize participant burden and to respect privacy, data on severity of diagnosis and length
292 of stay in hospital were not included, and so cannot be reported. As self-report and objective
293 assessment was not conducted at the exact same time, we are unable to directly compare
294 methods of assessment. As there was no way to ascertain if participants walked or engaged
295 in physical activity at a sufficient intensity to constitute MVPA, self-reported MVPA may be
296 over-estimated and may not directly translate to MVPA as assessed by accelerometry. More
297 work is needed therefore, to compare self-report and objective measures of MVPA and
298 sedentary behaviour in people with mental illness.

299

300

301

302 CONCLUSIONS

303 The study suggests that inpatient adults with mental illness can be physically active, with
304 many engaging in walking, in particular to have time away from the hospital environment.
305 However they spend a significant amount of time sedentary. This is important as prolonged
306 sedentary behaviour is associated with poor physical health and may contribute to reduced
307 life expectancy, which are more common among adults with mental illness than in the
308 general population. This study highlights the need for sedentary behaviour advice,
309 recommendations and interventions for psychiatric inpatients, in particular to redress time
310 spent doing nothing while in hospital.

311

312

313 PRACTICAL IMPLICATIONS

- 314 • Inpatient adults can be physically active with 65% of this study population meeting
315 the Australian Physical Activity Guidelines of at least 150 minutes per week.
- 316 • Walking is the most common type of activity.
- 317 • Inpatient adults with mental illness spend a significant amount of time sitting each
318 day, often doing nothing.
- 319 • Hospitals could explore options for non-sedentary activities on both weekdays and
320 weekend.

321

322

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325 gatekeeper approval to access their inpatient population. No financial support was granted
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327

328

329

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- 417
418
419
420

420 **Table 1**

421 Sociodemographic and health characteristics of participants

	Accelerometer	Survey
	n = 36	n = 101
Mean (SD) Age (years)	42.5 (13.6)	40.7 (14.5)
	n (%)	n (%)
Gender		
Female	30 (83.3)	73 (72.3)
Country of birth		
Australia	32 (88.9)	86 (85.1)
Household composition		
Single living alone	7 (19.4)	17 (16.8)
Single living with others / children	8 (22.2)	29 (28.7)
Couple without children	10 (27.8)	27 (26.7)
Couple with children	11 (30.6)	27 (26.7)
Employment situation		
Not working ^a	10 (27.8)	31 (30.7)
Pensioner on benefits (not old age)	10 (27.8)	27 (26.7)
Paid part time / casual work	6 (16.7)	21 (20.8)
Full time paid employment	10 (27.8)	21 (20.8)
Ability to manage on available income		
Impossible / Difficult all the time	14 (38.9)	29 (28.7)
Difficult some of the time	10 (27.8)	39 (38.6)
Not too bad	9 (25.0)	22 (21.8)

Easy	3 (8.3)	10 (9.9)
<hr/>		
Education		
School only	10 (27.8)	35 (34.7)
Trade certificate / Diploma	10 (27.8)	25 (24.8)
Bachelor / Post-graduate Degree	16 (44.4)	41 (40.6)
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Psychological Distress^b		
Low – Moderate (6 – 18)	11 (30.6)	28 (27.7)
High (19 – 30)	24 (66.7)	69 (68.3)
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Physical health		
Poor	12 (33.3)	28 (27.7)
Fair	16 (44.4)	43 (42.6)
Good	5 (13.9)	18 (17.8)
Very Good / Excellent	3 (8.3)	12 (11.0)
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Body Mass index (kg/m²)^c		
< 18.5	0 (0 – 0)	2 (2.0)
18.5 – 24.9	9 (25.0)	26 (25.7)
25 – 29.9	10 (27.8)	27 (26.7)
> 30	16 (44.4)	44 (43.6)
<hr/>		
Diagnosis^{c, d}		
Depression	27 (75.0)	62 (61.4)
Anxiety	1 (2.8)	6 (5.9)
Bipolar Affective Disorder	6 (16.7)	19 (18.8)
Psychosis ^e	2 (5.6)	11 (11.0)

Post Traumatic Stress Disorder	5 (13.9)	12 (11.9)
Other ^f	1 (2.8)	7 (7.0)

Notes

^a Not working: Looking for employment, full time house keeping, retired, studying, volunteering

^b Psychological distress derived from the Kessler 6

^c Data retrieved from participant's medical records

^d Diagnosis: It is noted that some participants had more than one primary diagnosis.

^e Psychosis: Schizophrenia, Schizoaffective Disorder; Psychotic Disorder

^f Other: Obsessive Compulsive Disorder; Eating Disorder; Personality Disorder

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426 **Table 2**

427 Domain specific self-reported physical activity duration (minutes/week)

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	Median (IQR)
Walking for transport	60 (10.0 – 131.25)
Walking for recreation and exercise	60 (0 – 150)
Vigorous gardening and yard work	0 (0 – 0)
Vigorous physical activity	0 (0 – 60)
Moderate physical activity	0 (0 – 30)
Total self-reported moderate-vigorous physical activity ^a	225 (101.25 – 600)

Notes

N = 101

Items reported as median (25th 75th percentile)

^a Total physical activity excludes vigorous gardening and yard work, and has vigorous activity weighted by two.

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436 **Table 3**

437 Domain specific self-reported sedentary behaviour duration (minutes/day)

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	Weekday	Weekend
	Median (IQR)	Median (IQR)
Travelling to and from places	30 (0 -60)	30 (0 -60)
Watching television	60 (0 -180)	60 (0 -180)
Using a computer	30 (0 -120)	10 (0 – 120)
Psycho-education group	60 (0 – 120)	0 (-)
Art therapy group	0 (0 – 120)	0 (-)
With a health professional ^a	67.5 (46.25 – 180)	20 (0 – 30)
Smoking	0 (-)	0 (-)
General relaxing (sitting or lying) ^b	120 (60 – 240)	120 (30 – 240)
Doing work ^c	0 (0 – 60)	0 (0 – 60)
Doing nothing (sitting or lying)	120 (60 – 240)	120 (30 – 240)
Total sedentary behaviour time	780 (555 - 1020)	600 (405 - 825)

Notes

N = 101

Items reported as median (25th 75th percentile)^a Doctor, Nurse, Psychologist, Social Worker or Occupational Therapist^b Example: reading, needle work (not watching television or using a computer)^c Example: homework, assignments, reading documents, writing NOT using a computer

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