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Mild cognitive deficits and everyday functioning among older adults in the community: The Monongahela-Youghiogheny Healthy Aging Team (MYHAT) Study

Tiffany F. Hughes, PhD, MPH, **Chung-Chou H. Chang, PhD**, **Joni Vander Bilt, MPH**, **Beth E. Snitz, PhD**, and **Mary Ganguli, MD, MPH**
Departments of Psychiatry (T.F.H., J.V.B., M.G.), Medicine (C-C.H.C.), and Neurology (B.S., M.G.), School of Medicine; and the Departments of Biostatistics (C.-C.H.C.) and Epidemiology (M.G.), Graduate School of Public Health, University of Pittsburgh, Pittsburgh, PA, USA

Abstract

Objective—A key component of successful aging in old age is the ability to independently perform instrumental activities of daily living (IADLs). We examined the ability to perform multiple IADL tasks in relation to mild cognitive impairment (MCI) defined on purely neuropsychological grounds.

Design—Cross-sectional study.

Setting—Population-based cohort in Southwestern Pennsylvania.

Participants—1,737 community-dwelling adults aged 65 years and older.

Measurements—Classification of MCI based on performance with reference to norms in the cognitive domains of memory, language, attention, executive and visuospatial function. The ability to perform seven IADL tasks (travel, shopping, meal preparation, housework, taking medications, handling personal finances, and telephone use) as assessed by the Older Americans Resources and Services (OARS) scale.

Results—Those with cognitively defined MCI were more likely to be dependent in at least one IADL task, and in each individual IADL task, than cognitively normal participants. Better memory and executive functioning were associated with lower odds of IADL dependence in MCI. Across the subtypes of MCI, those with the multiple-domain amnestic subtype were the most likely to be dependent in all IADL tasks; with better executive functioning associated with lower risk of dependence in select IADL tasks in this group.

Conclusions—Mild impairment in cognition is associated with difficulty performing IADL tasks at the population level. Understanding these associations may help improve prediction of the outcomes of MCI. It may also allow appropriate targeting of cognitive interventions in MCI to potentially help preserve functional independence.

Keywords

cognition; mild cognitive impairment; everyday functioning; instrumental activities of daily living; epidemiology; community; population

Corresponding author: Tiffany F. Hughes, PhD, MPH, Department of Psychiatry, University of Pittsburgh School of Medicine, 3600 Forbes Avenue, Suite 205, Pittsburgh, PA 15213. Telephone: 412-647-6619; Fax: 412-647-6555; hughest2@upmc.edu.

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OBJECTIVE

Instrumental activities of daily living such as handling personal finances, going shopping, preparing meals, and managing medications are important for independent living in late life and heavily reliant upon cognitive skills (1–6). Although the original criteria for mild cognitive impairment (MCI) required “essentially normal” activities of daily living (7), evidence is growing that individuals with mild cognitive impairment, recruited from both clinic- (8–10) and community-based (11–19) sources, have at least subtle deficits in everyday functioning compared with their cognitively normal peers. Further, everyday functioning in MCI predicts subsequent progression to dementia (11, 14), which may account for the elevated progression rate from MCI to dementia observed in the clinical studies. Functional deficits may be more pronounced among those with MCI in clinic-based samples than in community-based ones (20) because these individuals are likely seeking services because of these difficulties.

Few epidemiologic, population-based studies have examined differences in IADL deficits across the subtypes of MCI, and identified the specific patterns of relations between different cognitive domains and different IADL tasks in MCI. The validity, utility, and predictive value of the MCI concept would be extended beyond clinical settings and volunteer samples if we better understood the precise nature and extent of functional deficits in MCI in the community at large. Since those with poorer cognitive performance (21) and MCI (12) experience faster decline in functional abilities, understanding these associations may also guide interventions to enhance cognitive functioning.

We examined the associations between cognitive functioning and everyday functioning in a population-based cohort study, using a purely neuropsychological (cognitive) definition of MCI unrelated to everyday functioning (22). We hypothesized that those with MCI, especially when multiple cognitive domains were impaired, would be more likely to report IADL difficulties than those with normal cognition. Further, we hypothesized that better test performance in memory and executive functioning would be associated with lower odds of IADL dependence among those with MCI.

METHODS

Participants

The Monongahela – Youghiogheny Health Aging Team (MYHAT) study is a population-based cohort study of cognitive impairment in the community. Additional details regarding the study area, sampling, recruitment, and assessment are published elsewhere (23). Inclusion criteria were (a) age 65 years or older, (b) living within the selected area of Southwestern, PA, (c) non-institutionalized, (d) not too ill to participate, (e) physically capable of completing neuropsychological assessment, and (f) not decisionally incapacitated. A total of 2,036 participants were recruited through age-stratified random sampling from voter registration lists between 2006 and 2008. At the baseline assessment, 54 participants who scored <21/30 on the Mini-Mental State Examination (MMSE) (24), after correcting for age and education (25), were classified as moderately to severely impaired and thus unsuited to study MCI. The remaining 1,982 underwent a detailed assessment comprising several components including the neuropsychological and everyday functioning assessments that are the focus of this report. Written informed consent was obtained from all participants following a protocol approved by the University of Pittsburgh Institutional Review Board.

Cognition

Cognitive functioning was assessed using a battery of neuropsychological tests designed to tap the cognitive domains of attention (Trailmaking test A (26), digit span forward (27)); executive function (Trailmaking test B (26), clock drawing (28), verbal fluency for initial letters P & S (29)); memory (WMS-R logical memory (immediate and delayed recall; 27), WMS-R visual reproduction (immediate and delayed recall; 27)), Fuld Object Memory Evaluation (30)); language (Boston naming test (31), verbal fluency for categories (29), Indiana University Token Test (32)); and visuospatial function (WAIS-III block design (33)). Composite scores were calculated for each cognitive domain as described previously (23). Normative reference points for each cognitive domain composite (34) were used to develop a purely cognitively based classification into normal cognition, amnestic MCI (single and multiple domain), non-amnestic MCI (single and multiple-domain) and severe cognitive impairment (22). The MYHAT study has explored additional definitions of MCI (22), but for the current analysis we used this purely cognitive definition so as to determine its relationship with everyday functioning.

Everyday Functional Ability

The ability to perform instrumental activities of daily living (IADLs) was assessed with the Older Americans Resources and Services (OARS) scale (35). This includes seven activities: getting to places outside of walking distance ("travel"), using the telephone, going shopping, preparing own meals, doing housework, managing medications, and handling personal finances. Participants respond whether they can perform each activity independently, with some help, or not at all. The OARS assessment does not distinguish among functional impairments due to physical (motor or sensory) or mental (cognitive or motivation) deficits. We dichotomized everyday functional ability as independent (able to perform the activity independently) versus dependent (with some help or not at all). A total IADL impairment score was derived by summing the responses for a possible range of 0–7 with higher scores representing greater dependence. The majority (86.82%) of this normal or only mildly impaired cohort reported being able to perform all IADLs independently. As their median IADL score was 0, we used a total score of 1 or greater as the threshold for IADL dependence.

Covariates

Covariates included age (continuous), gender, education (< high school vs. high school vs. > high school), and race (White vs. non-White). Other covariates included factors known to be associated with cognitive performance and everyday functioning: (a) global cognitive ability based on the Mini-Mental State Exam (MMSE (24); continuous); (b) depressive symptoms measured using the modified Center for Epidemiologic Studies-Depression scale (mCES-D (36), 0 vs. 1–2 (50^{th} percentile) vs. ≥ 3 symptoms (90^{th} percentile) (23)); (c) vision classified as normal (able to read without correction) vs. abnormal, corrected (e.g., eye glasses) vs. abnormal, not corrected; (d) hearing classified as normal (able to carry on a conversation without correction) vs. abnormal, corrected (e.g., hearing aid) vs. abnormal, uncorrected; and (e) overall health, as measured by the number of regularly taken prescription medications (0 vs. 1–3 vs. ≥ 4) and self-rated health (poor/fair vs. good vs. very good/ excellent).

Data Analysis

All statistical analyses were conducted using SAS version 9.2 (37). We first examined the characteristics of the study sample by cognitive status using χ^2 test for categorical variables and ANOVA for continuous variables. We then compared MCI, the four MCI subtypes, and normal cognitive status, in relation to each IADL task using Fisher's exact test. For these

analyses, we interpreted p-values < 0.01 (two-tailed) as statistically significant to account for multiple comparisons.

We fit logistic regression models to better understand the independent associations of specific cognitive domain(s) with IADL dependence in overall MCI, and the MCI subtypes. We estimated the relationships between cognitive domain performance and dependence in each of the IADL tasks shown to differ between all MCI, the four MCI subtypes, and normal cognitive status. For the final multivariable models including overall MCI, we selected from the preliminary models only the cognitive domains significantly associated with IADL ability ($p < 0.05$), and only the covariate measures significantly associated with each IADL task after adjusting for age, gender, and education. In the final multivariable models for each MCI subtype, due to the relatively small sample size of the subtypes, we used p-value < 0.10 to select the cognitive domains for inclusion, and included no covariates.

RESULTS

Sample Characteristics

Of the original 1,982 baseline participants, we included 1,737 (87.64%) who had complete data on all IADL and covariate measures and had sufficient data to be classified by our cognitive criteria as having normal cognition or MCI. We excluded those with scores in two or more cognitive domains worse than 2.0 SD below appropriate norms (i.e., severe cognitive impairment; 22) in order to minimizes the risk of misclassification. Compared with the entire sample of 1,982, these 1,737 individuals were more likely to be independent in all IADL tasks (86.82% vs. 83.17%, $\chi^2 = 9.48$ (df=1), $p = 0.002$), and specifically in travel (96.43% vs. 93.78%, $\chi^2 = 13.69$ (df=1), $p = 0.0002$), medication management (98.68% vs. 96.45%, $\chi^2 = 18.69$ (df=1), $p < 0.0001$), handling finances (98.62% vs. 96.11%, $\chi^2 = 22.03$ (df=1), $p < 0.0001$), shopping (95.22% vs. 92.32%, $\chi^2 = 12.75$ (df=1), $p = 0.004$), housework (88.66% vs. 86.07%, $\chi^2 = 5.55$ (df=1), $p = 0.02$), telephone use (100% vs. 99.65%, $\chi^2 = 6.16$ (df=1), $p = 0.01$), and meal preparation (97.58% vs. 95.51%, $\chi^2 = 11.64$ (df=1), $p = 0.006$).

Among these 1,737 participants, 1,114 were classified as cognitively normal and 623 (35.9%) were cognitively classified as MCI. MCI subtypes included 78 participants with single-domain amnestic; 136 with multiple-domain amnestic; 289 with single-domain non-amnestic; and 120 with multiple-domain non-amnestic. Compared with the cognitively normal, those with MCI were significantly more likely to be non-White, have lower MMSE scores, and be less likely to rate their own health as very good or excellent compared with poor or fair (32.26% vs. 41.29%, $\chi^2 = 13.82$ (df=1), $p < 0.001$) (Table 1).

MCI and Everyday Functioning

Of the 1,737 participants, 229 (13.18%) lacked independence in one or more of the seven IADL items. The n (%) of participants dependent in each individual IADL activity were: 62 (3.57%) for travel, 83 (4.78%) for shopping, 197 (11.34%) for housework, 42 (2.42%) for meal preparation, 23 (1.32%) for managing medications, 24 (1.38%) for handling personal finances, and 0 for using the telephone. Because no participants were dependent in using the telephone, this IADL item was not included in subsequent analyses.

Differences were found between overall MCI, each of the MCI subtypes, and the normal cognitive group, across the IADL tasks (Table 2). Compared to the cognitively normal group, those with MCI were significantly more likely to be dependent in one or more IADL tasks, and also in each individual IADL task. Those with single-domain amnestic MCI were more likely to be dependent in managing their medications. Those with multiple-domain

MCI, both amnestic and non-amnestic, were more likely to be dependent in one or more IADL tasks, and in most individual IADL tasks.

Cognitive Domain Performance and Everyday Functioning among those with MCI

Among all MCI, those with higher memory performance were less likely to be dependent in one or more IADL tasks (Odds Ratio (OR) = 0.66, 95% Confidence Interval (CI): 0.44–0.99, Wald χ^2 = 3.92 (df = 1), p-value = 0.05), meal preparation (OR = 0.46, 95% CI: 0.22–0.97, Wald χ^2 = 3.39 (df = 1), p-value = 0.04), and medication management (OR = 0.24, 95% CI: 0.09–0.60, Wald χ^2 = 9.10 (df = 1), p-value < 0.01). Those with higher executive functioning were also less likely to be dependent in traveling (OR = 0.43, 95% CI: 0.23–0.78, Wald χ^2 = 7.68 (df = 1), p-value < 0.01), shopping (OR = 0.54, 95% CI: 0.32–0.93, Wald χ^2 = 4.94 (df = 1), p-value = 0.03), and medication management (OR = 0.37, 95% CI: 0.16–0.88, Wald χ^2 = 5.12 (df = 1), p-value = 0.02). Those with higher visuospatial ability were less likely to be dependent in handling finances (OR = 0.32, 95% CI: 0.12–0.89, Wald χ^2 = 4.76 (df = 1), p-value = 0.03).

Across the four MCI subtypes, only the domain of executive functioning was associated with the ability to perform IADL tasks in those with multiple-domain amnestic MCI. Better executive functioning was associated with lower odds of dependence in one or more IADL tasks (OR = 0.26, 95% CI: 0.10–0.71, Wald χ^2 = 15.24 (df = 1), p-value < 0.01), travel (OR = 0.34, 95% CI: 0.14–0.81, Wald χ^2 = 5.92 (df = 1), p-value = 0.02), shopping (OR = 0.38, 95% CI: 0.17–0.84, Wald χ^2 = 5.63 (df = 1), p-value = 0.02), and medication management (OR = 0.31, 95% CI: 0.11–0.86, Wald χ^2 = 5.08 (df = 1), p-value = 0.02). As noted, the sample sizes for the subtypes were small.

CONCLUSIONS

Most participants in this cross-sectional study were independent in all IADL tasks, as expected in a population-based cohort restricted to older adults with normal or mildly impaired cognition. Those neuropsychologically classified as MCI were more likely to be dependent in multiple functional tasks than those with normal cognition. Better performance in different cognitive domains was associated with lower odds of dependence in different IADL tasks; higher scores in the domains of memory and executive functioning were most consistently associated with lower odds of IADL dependence. These findings extend previous literature, showing that those with neuropsychologically defined MCI from a population-based sample have difficulties completing many IADL tasks independently, as previously demonstrated in volunteer (11–19) and clinic samples (8–10). Memory and executive function are especially important for IADL independence in MCI. This is among the few population-based studies to look for different patterns of functional dependence across the subtypes of MCI.

The criterion of “essentially intact activities of daily living” in MCI has commonly been interpreted to mean that basic ADLs are intact (7). However, the type of, and extent to which, IADLs may be impaired are less clear, e.g., whether needing some help should be defined as impaired or unimpaired (38, 39). Impairments in IADLs typically precede impairment in basic ADLs, in relation to cognitive decline (40). We found that those with multiple-domain MCI, both amnestic and non-amnestic, were dependent in the greatest number of IADL tasks. This confirms previous work (12, 13, 15–17), and suggests that multi-domain MCI is close to the dementia threshold. However, these are cross-sectional data. Longitudinal follow-up of the cohort over time will determine how well cognitive performance predicts IADL decline and dementia over time. MCI has been demonstrated to show a higher rate of progression to dementia when IADL impairments are present than when they are not, and the number of IADLs impaired is associated with risk of progression

(11, 14, 41). Follow-up of our cohort will also show how best combining IADL and cognitive measurements into the definition of MCI can improve the accuracy of predicting progression from MCI to dementia.

The current DSM-IV definition of dementia (42) requires cognitive impairment to be sufficient to interfere with social and occupational functioning. The DSM-5 Study Group on Function has noted that functional impairment is a consequence of mental disorders and cannot therefore be a diagnostic criterion for disorders. Instead, once diagnosed, disorders should be rated on the presence or severity of functional impairment (43). The DSM-5 Work Group on Neurocognitive Disorders has posted draft criteria (www.dsm5.org) referring to "functional independence," as opposed to functional impairment, in defining neurocognitive disorders. Thus, our observations may help inform clinical diagnostic criterion development processes for these conditions, including those currently referred to as MCI and dementia.

The ability to perform complex IADLs relies heavily on cognitive skills (1–6). Most (2, 9, 18–19, 44–47) but not all (17) studies show that memory and executive functioning are particularly important domains for IADL functioning, since the ability to plan, organize, and remember underlies the performance of most complex tasks. We confirmed these associations in our overall MCI group and also in the multiple domain amnestic MCI subgroup. Understanding the specific cognitive domains that account for IADL difficulties among those with MCI could potentially guide the design of interventions to improve both cognitive and functional outcomes. For example, knowledge that patients with amnestic MCI are likely to have difficulty managing their medication should prompt clinicians and caregivers to implement specific plans to ensure adherence to medication regimens in such patients. Further, cognitive interventions targeting the domains of memory and executive function may hold the greatest promise in improving everyday abilities among those with MCI (48–49).

As regards clinical implications, health care providers should recognize that even individuals with mild objective cognitive deficits are at risk of having difficulty with certain instrumental activities of daily living, especially if multiple cognitive domains are impaired. Further, clinicians and families often underestimate the role of cognitive functioning in IADL ability by attributing IADL difficulties to sensory or motor deficits or other physical or mental health problems (50–51). In our sample, MCI was associated with IADL dependence while sensory function, depressive symptoms, and overall morbidity measured by number of prescription medications were not. A previous study also found hippocampal volume, memory, and processing speed were associated with amnestic MCI, but not demographic characteristics, physical health, or depression (19). Thus, clinicians should carefully evaluate cognition in individuals with IADL difficulties regardless of comorbid conditions.

The following cautions should be exercised in interpreting our data. The OARS assessment of IADL ability is a well-validated self-report measure with a long history of use in population studies. However, it possibly lacks sensitivity to subtle changes in everyday functioning, as suggested by the high proportion of our cohort that reported total IADL independence. Further, the OARS data may be biased by participants inaccurately reporting their abilities, although a recent study suggests that, overall, MCI participants are as accurate in reporting their functional ability as their unimpaired peers (52). We lack performance-based IADL assessments which could determine whether participants were under-reporting their functional limitations. The OARS assessment also does not evaluate the underlying cause of the IADL impairment, i.e., whether cognitive, physical, or a combination thereof account for the impairment. Our cognitive classification is based solely on test performance relative to norms from the same population-based cohort. It is possible that either normal or

demented participants may have been misclassified as MCI. Misclassifying participants with dementia as MCI may have over-estimated the relationship between MCI and IADL impairment in our analyses. However, misclassification is likely minimal given the relatively low frequency of IADL impairment in this sample.

Our sample was large and randomly selected from the target communities in economically disadvantaged small-towns of Southwestern Pennsylvania, making our results generalizable to older adults in similar populations. However, since this population is largely White, our results should be replicated in more ethnically diverse samples. Being population-based, our cohort minimizes the selection bias typical of clinic-based studies where individuals are referred because of perceived impairments (53). Ours is one of few population-based studies to use a purely cognitive definition of MCI that is independent of functional ability, thus allowing us to examine the relationship between cognition and IADLs. We were able both to characterize the links between MCI subtypes and different IADL abilities, and to identify the cognitive domains that are important for performing different IADL tasks among those with MCI. Thus, of relevance to both clinical practice and research, even minor cognitive deficits can be detrimental to community-dwelling older adults' functional independence.

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Table 1

Participant Characteristics according to Their Cognitive Classification

	All	Normal	MCI	Test Statistic, (df)	p-value
N	1,737	1,114	623		
Age [m (SD)]	77.23 (7.33)	76.95 (7.29)	77.72 (7.38)	F = 4.33, (1, 1735)	0.04
Gender (n (%) female)	1,089 (62.69)	694 (62.30)	395 (63.40)	χ^2 = 0.65, (1)	0.65
Education				χ^2 = 0.58, (2)	0.75
n (%) < HS	230 (13.24)	150 (13.46)	80 (12.84)		
n (%) = HS	782 (45.02)	494 (44.34)	288 (46.23)		
n (%) > HS	725 (41.74)	470 (42.19)	255 (40.93)		
Race (n (%) White)	1,652 (95.11)	1087 (97.58)	565 (90.69)	χ^2 = 40.71, (1)	<0.001
Global cognition (MMSE; mean [SD])	27.19 (2.19)	27.63 (1.93)	26.39 (2.39)	F = 139.93, (1, 1735)	<0.0001
Depressive symptoms (mCES-D)				χ^2 = 6.14, (2)	0.05
n (%) score = 0	1,206 (69.43)	795 (71.36)	411 (65.97)		
n (%) score = 1–2	334 (19.23)	205 (18.40)	129 (20.71)		
n (%) score ≥ 3	197 (11.34)	114 (10.23)	83 (13.32)		
Vision				χ^2 = 0.69, (2)	0.71
n (%) normal	101 (5.81)	62 (5.57)	39 (6.26)		
n (%) abnormal, corrected	1,625 (93.55)	1,044 (93.72)	581 (93.26)		
n (%) abnormal, uncorrected	11 (0.63)	8 (0.72)	3 (0.48)		
Hearing				χ^2 = 4.56, (2)	0.10
n (%) normal	1,401 (80.66)	911 (81.78)	490 (78.65)		
n (%) abnormal, corrected	232 (13.36)	146 (13.11)	86 (13.80)		
n (%) abnormal, uncorrected	104 (5.99)	57 (5.99)	47 (7.54)		
Prescription medications				χ^2 = 2.61, (2)	0.27
n (%) meds = 0	160 (9.21)	110 (9.87)	50 (8.03)		
n (%) meds = 1–3	642 (36.96)	418 (37.52)	224 (35.96)		
n (%) meds ≥ 4	935 (53.83)	586 (52.60)	349 (56.02)		
Self-rated health				χ^2 = 18.66, (2)	<0.001

	All	Normal	MCI	Test Statistic, (df)	p-value
n (%) poor/fair	280 (16.12)	155 (13.91)	125 (20.06)		
n (%) good	796 (45.83)	499 (44.79)	297 (47.67)		
n (%) very good/excellent	661 (38.05)	460 (41.29)	201 (32.26)		

Note: P-values estimated using χ^2 test for categorical variables and ANOVA for continuous variables. HS = High School, MMSE = Mini Mental State Examination, mCES-D = modified Center for Epidemiologic Studie Depression scale.

Table 2

Pairwise Comparisons between Cognitively Normal and MCI Participants' Everyday Functional Ability

	Normal	MCI	p-value	aMCI, single	p-value	aMCI, multi	p-value	naMCI, single	p-value	naMCI, multi	p-value
N	1,114	623	.	78	.	136	.	289	.	120	.
Total IADL, n (%)dependent	113 (10.14)	116 (18.62)	<0.0001	11 (14.10)	0.2523	34 (25.00)	<0.0001	44 (15.22)	0.0208	27 (22.50)	<0.001
Travel, n (%)dependent	22 (1.97)	40 (6.42)	<0.0001	3 (3.85)	0.2213	16 (11.76)	<0.0001	10 (3.46)	0.1808	11 (9.17)	<0.001
Finances, n (%)dependent	4 (0.36)	20 (3.21)	<0.0001	1 (1.28)	0.2875	6 (4.41)	<0.0001	2 (0.69)	0.6093	11 (9.17)	<0.0001
Meal Prep., n (%)dependent	12 (1.08)	30 (4.82)	<0.0001	2 (2.56)	0.2319	12 (8.82)	<0.0001	9 (3.11)	0.0242	7 (5.83)	0.0013
Shopping, n (%)dependent	28 (2.51)	55 (8.83)	<0.0001	4 (5.13)	0.1517	19 (13.97)	<0.0001	16 (5.54)	0.013	16 (13.33)	<0.0001
Medication, n (%)dependent	3 (0.27)	20 (3.21)	<0.0001	3 (3.85)	0.0047	12 (8.82)	<0.0001	2 (0.69)	0.2749	3 (2.50)	0.0144
Housework, n (%)dependent	105 (9.43)	92 (14.77)	<0.001	8 (10.26)	0.8408	24 (17.65)	0.0065	38 (13.15)	0.0644	22 (18.33)	0.0042

Notes: P-values estimated using Fisher's Exact Test

aMCI, single = single-domain amnestic MCI; aMCI, multi = multiple-domain amnestic MCI; naMCI, single = single-domain non-amnestic MCI; naMCI, multi = multiple-domain non-amnestic MCI.

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