

Frequency of bowel movements and the future risk of Parkinson's disease

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Article abstract—*Background:* Constipation is frequent in PD, although its onset in relation to clinical PD has not been well described. Demonstration that constipation can precede clinical PD could provide important clues to understanding disease progression and etiology. The purpose of this report is to examine the association between the frequency of bowel movements and the future risk of PD. *Methods:* Information on the frequency of bowel movements was collected from 1971 to 1974 in 6790 men aged 51 to 75 years without PD in the Honolulu Heart Program. Follow-up for incident PD occurred over a 24-year period. *Results:* Ninety-six men developed PD an average of 12 years into follow-up. Age-adjusted incidence declined consistently from 18.9/10,000 person-years in men with <1 bowel movement/day to 3.8/10,000 person-years in those with >2/day ($p = 0.005$). After adjustment for age, pack-years of cigarette smoking, coffee consumption, laxative use, jogging, and the intake of fruits, vegetables, and grains, men with <1 bowel movement/day had a 2.7-fold excess risk of PD versus men with 1/day (95% CI: 1.3, 5.5; $p = 0.007$). The risk of PD in men with <1 bowel movement/day increased to a 4.1-fold excess when compared with men with 2/day (95% CI: 1.7, 9.6; $p = 0.001$) and to a 4.5-fold excess versus men with >2/day (95% CI: 1.2, 16.9; $p = 0.025$). *Conclusions:* Findings indicate that infrequent bowel movements are associated with an elevated risk of future PD. Further study is needed to determine whether constipation is part of early PD processes or is a marker of susceptibility or environmental factors that may cause PD.

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Constipation is frequent in patients with PD.¹⁻¹⁷ Case reviews further suggest that constipation can precede the extrapyramidal symptoms of clinical PD by many years.^{1,2} Such reviews, however, are subject to uncertain recall of constipation histories and to confounding due to episodes of constipation that can occur naturally with advancing age.

Clear demonstration that constipation can precede clinical PD is important because it suggests that recognition of pathogenic mechanisms in the PD process could occur before the emergence of motor symptomatology. Identification of constipation as a risk factor for PD could also help identify early or suspected disease and provide for opportunities to develop or investigate intervention strategies. Unfortunately, there are no prospective follow-up studies that confirm that constipation can precede the clinical manifestations of PD. The purpose of this report is to examine the association between the frequency of bowel movements and the future risk of PD based on 24 years of follow-up of a cohort of asymptomatic men enrolled in the Honolulu Heart Program.

Materials and methods. *Study sample.* From 1965 to 1968, the Honolulu Heart Program began following 8006 men of Japanese ancestry living on the island of Oahu, HI, for the development of cardiovascular disease.¹⁸⁻²⁰ At the time of study enrollment, subjects were aged 45 to 68 years. Initial screening consisted of a baseline physical examination and documentation of cardiac and neurologic conditions to identify prevalent cases of cardiovascular disease. Procedures were in accordance with institutional guidelines and approved by an institutional review committee. Informed consent was obtained from the study participants.

The Honolulu Heart Program is now in its 36th year of follow-up. During this period, surviving members of the original cohort participated in repeat examinations and were tracked for morbidity and mortality outcomes through a comprehensive system of surveillance that included a review of hospital discharges, death certificates, and autopsy records. As of 1990, less than 1% of the original cohort had moved off the island of Oahu resulting in an out-migration rate of about one per thousand per year. Validity studies have indicated that nearly 100% of hospital discharge events have been identified.

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For this report, follow-up for incident PD began at a repeat examination that occurred from 1971 to 1974 when information on the frequency of bowel movements was first collected. Subjects examined included 6860 men, approximately 90% of the surviving members of the original cohort. After exclusion of 64 men with missing bowel movement data and six men with prevalent PD, 6790 men remained for follow-up.

Frequency of bowel movements and confounding information. At the time when follow-up began (1971 to 1974), study participants were asked about their usual daily bowel movement frequency and categorized as having <1, 1, 2, and >2 bowel movements/day. Information on the use of laxatives was also collected. Other confounding information collected at the beginning of follow-up and known to be related to PD included age, pack-years of cigarette smoking, and intake of coffee.^{21,22} Participants were also asked about jogging and intake of fruits, vegetables, and grains. Men were defined to be joggers if they reported that they jogged or ran intermittently or regularly without further characterization in terms of distance and intensity. While other measures of physical activity were not available when follow-up began (1971 to 1974), a physical activity index (an overall measure of 24-hour metabolic output) that was measured at the time of study enrollment (1965 to 1968) was also assessed.²³ Measurement of food and coffee intake was based on a food frequency questionnaire in which subjects were asked about consumption of these items during the previous week.²¹

PD case finding and diagnosis. For this report, 24 years of follow-up data are available on incident PD after collection of information on bowel movement frequency (1971 to 1974). Prior to 1991, cases of PD were identified through a review of all hospital records of cohort members for new and preexisting diagnoses of PD, an ongoing review of all Hawaii death certificates, and a review of medical records at the offices of local neurologists for all cohort members with PD identified within the previous 25 years.

Beginning in 1991, the diagnosis of PD was based on a complete screening of the participating cohort at examinations that occurred from 1991 to 1993 and again from 1994 to 1996. All subjects were questioned about diagnoses of PD, symptoms of parkinsonism (any two of rest tremor, bradykinesia, rigidity, or postural instability), and PD medications by a structured interview. Those with a history or sign of parkinsonism were referred to a study neurologist who administered standardized questions about symptoms and onset of parkinsonism, previous diagnoses, and medication use, followed by a comprehensive and standardized neurologic examination. A diagnosis of PD was based on consensus among the study neurologists according to published criteria.²⁴ These required that the subject have the following: 1) parkinsonism; 2) a progressive disorder; 3) any two of a marked response to levodopa, asymmetry of signs, asymmetry at onset, or initial onset tremor; and 4) absence of any etiology known to cause similar features. Cases of parkinsonism related to progressive supranuclear palsy, multisystem atrophy, cerebrovascular disease, drug-induced parkinsonism, post-encephalitic parkinsonism, or post-traumatic parkinsonism were not included among the cases of PD. Further description of PD case finding and diagnosis is described elsewhere.^{21,25}

Statistical methods. Crude and age-adjusted incidence rates of PD in person-years were estimated according to bowel movement frequency based on the 24 years of follow-up available in the 6790 men who were examined from 1971 to 1974.²⁶ Age-adjusted risk factors across levels of bowel movement frequency were also derived.²⁶ To test for an independent effect of bowel movement frequency on PD after adjusting for age and the other covariates, proportional hazards regression models were used.²⁷ In this instance age, coffee intake, pack-years of cigarette smoking, and combined intake of fruits, vegetables, and grains were modeled as continuous variables, while jogging and laxative use were modeled as dichotomous variables (yes versus no). While frequency of bowel movements was modeled as a continuous risk factor, relative risks of PD (and associated confidence intervals) were also estimated comparing the risk of PD for men with <1 bowel movement/day to men with 1, 2, and >2/day. All reported *p* values were based on two-sided tests of significance.

Results. The average age of the 6790 men was 60 years (range: 51 to 75) at the time when questions were asked about usual bowel movement frequency (1971 to 1974). Over the 24-year course of follow-up, 96 men developed PD. The average age at the time of diagnosis was 73 years (range: 55 to 90), and the average time to diagnosis was 12 years (range: 2 months to 24 years).

Table 1 shows the percent of men with <1, 1, 2, and >2 bowel movements/day and the use of laxatives according to age when follow-up began. Approximately two-thirds of the men reported having 1 bowel movement/day while a quarter reported having 2/day. Overall, 4.3% of the men had <1 bowel movement/day and 6.3% had >2/day. The percent of men with infrequent bowel movements (<1/day) rose from 3.6% in men aged 51 to 55 years to 9.1% of men aged 71 to 75 (*p* < 0.001) whereas the percent of men with >2/day declined from 6.8 to 3.6% (*p* = 0.015). Although associations appear modest, the percent of men with 1 bowel movement/day also increased with age whereas the percent of men with 2/day declined. Along with the increase in infrequent bowel movements with advancing age (<1/day), there was also an increase in the reported use of laxatives. Laxative use increased from 16.4% in the youngest group of men to 29.6% in those who were the oldest (*p* < 0.001).

Table 2 describes the way in which age and the age-adjusted covariates varied according to bowel movement frequency. Age, coffee intake, and use of laxatives declined with increasing number of bowel movements/day (*p* < 0.001). Daily consumption of coffee in men with <1 bowel movement/day was (on average) 3.4 oz more than in men with >2/day (14.0 versus 10.6 oz/day). The percent of men who used laxatives was more than doubled in men with infrequent bowel movements (<1/day) as compared with men who had >2/day (44.7 versus 18.0%). Pack-years of smoking appeared to increase with frequency of bowel movements (*p* = 0.033), although there was no relation with the percent of men who were current and past cigarette smokers. Although jogging was not significantly related to bowel movement frequency, the percent of men who jogged was nearly doubled in men with >2 bowel movements/day (11.1%) versus men with <1/day (5.9%). Intake of fruits, vegetables, and grains increased significantly but modestly with increasing bowel movement frequency.

Table 1 Percent of men with <1, 1, 2, and >2 bowel movements/day and percent of men who used laxatives according to age at the beginning of study follow-up (1971 to 1974)

Age	Sample size	Bowel movements/d				Laxative use (1402)
		<1 (289)*	1 (4371)	2 (1704)	>2 (426)	
51–55	1642	3.6	61.7	27.9	6.8	16.4
56–60	2421	3.8	63.4	26.2	6.6	19.3
61–65	1353	3.4	65.7	23.9	7.0	21.2
66–70	1011	5.7	69.0	20.6	4.7	26.8
71–75	363	9.1	65.0	22.3	3.6	29.6
Test for trend	—	$p < 0.001†$	$p < 0.001†$	$p < 0.001‡$	$p = 0.015‡$	$p < 0.001†$
Overall	6790	4.3	64.4	25.1	6.3	20.6

* Sample size.

† Significant increase with age.

‡ Significant decrease with age.

The incidence of PD according to frequency of bowel movements is shown in table 3. Both unadjusted and age-adjusted incidence increased consistently with decreasing bowel movement frequency. The age-adjusted incidence of PD increased from 3.9/10,000 person-years in men with >2 bowel movements/day to 18.9/10,000 person-years in men with <1/day ($p = 0.005$). Although modest, the average age at PD diagnosis declined consistently with decreasing bowel movement frequency. Men with infrequent bowel movements (<1/day) had a diagnosis of PD that was an average of 18 months sooner than those with >2 bowel movements/day. This latter association was not significant.

Table 4 further describes the estimated relative risk of PD in men with <1 bowel movement/day versus men whose bowel movements were more frequent. After adjustment for age and the other covariates, men with <1 bowel movement/day had a 2.7-fold excess risk of PD versus men with 1/day (95% CI: 1.3, 5.5; $p = 0.007$). The risk of PD in

men with <1 bowel movement/day increased to a 4.1-fold excess when compared with men with 2/day (95% CI: 1.7, 9.6; $p = 0.001$) and to a 4.5-fold excess versus men with >2/day (95% CI: 1.2, 16.9; $p = 0.025$).

Although data may be too limited to carefully assess time-varying effects, the association between the frequency of bowel movements and the risk of PD appeared similar for diagnoses made early versus later into follow-up. As compared with men with ≥ 1 bowel movement/day, men whose bowel movements were less frequent had a 2.9-fold excess risk of PD in the first 12 years of follow-up (95% CI: 1.1, 7.6; $p = 0.030$) and a similar 3-fold excess for diagnoses that were made in the 12-year period that followed (95% CI: 1.0, 8.6; $p = 0.042$).

Discussion. Recall bias is a major weakness of case-control studies in describing an association between constipation and future risk of clinical PD.^{1,2}

Table 2 Average age and age-adjusted covariates according to bowel movement frequency at the beginning of study follow-up (1971 to 1974)

Covariate	Bowel movements/d			
	<1 (289)*	1 (4371)	2 (1704)	>2 (426)
Age¶	61.5 ± 6.3†	60.3 ± 5.5	59.6 ± 5.4	59.5 ± 5.0
Coffee intake, oz/d¶	14.0 ± 11.6	12.9 ± 11.1	12.0 ± 11.8	10.6 ± 9.3
Pack-years of smoking‡	34.4 ± 35.5	34.2 ± 32.5	34.5 ± 32.8	39.1 ± 35.5
Current smoking status				
Past, %	32.4	37.3	36.9	32.0
Current, %	36.3	34.3	32.9	39.5
Laxative use, %¶	44.7	20.7	17.0	18.0
Jogging, %	5.9	9.1	8.8	11.1
Intake of fruits, vegetables, and grains, g/d§	438 ± 246	432 ± 242	443 ± 250	468 ± 303

* Sample size.

† Mean ± standard deviation.

‡ Significant increase with increasing bowel movement frequency ($p = 0.033$).

§ Significant increase with increasing bowel movement frequency ($p = 0.011$).

¶ Significant decrease with increasing bowel movement frequency ($p < 0.001$).

Table 3 Incidence of PD according to frequency of bowel movements

Bowel movements/d	Sample size	Incident PD cases	Incidence, rate/10,000 person-years	
			Unadjusted	Age-adjusted
<1	289	10	19.6	18.9
1	4371	66	8.0	7.9
2	1704	17	5.2	5.4
>2	426	3	3.8	3.9
Test for trend	—	—	$p = 0.002$	$p = 0.005$
Overall	6790	96	7.5	—

Patients with PD may be prone to errors in reporting of past symptoms because of uncertain recall of constipation histories that may have predated a diagnosis of PD by many years.

The major strength of this report is that data are from individuals who were asked about usual bowel movement frequency an average of 12 years prior to the development of PD. Bias that might have been introduced through the use of medications for PD is also absent. Although constipation has always been known to coexist in patients with PD, this is the first large-scale prospective study to show a significant association between infrequent bowel movements and an elevated risk of PD in later life. In addition, the risk of PD increased consistently as frequency of bowel movements decreased. Although not significant, data further suggest that infrequent bowel movements (<1/day) are also associated with an ear-

lier age at onset of PD. Among the men with PD, a diagnosis was made before the age of 60 years in two of the 10 men (20%) with <1 bowel movement/day, six of the 66 men (9.1%) with 1/day, and in none of the 20 men with ≥ 2 /day. Infrequent bowel movements also appeared to be associated with an elevated risk of PD for diagnoses made early and late into the 24-year follow-up considered in this report. Whether these findings can be duplicated in other prospective studies and extended to include women and other ethnic groups warrants further study.

Although there exists the possibility of diagnostic misclassification among the PD cases, with some having multiple-system atrophy rather than PD, the number of such instances is likely to be small.²⁸ In the current report, the chance of a diagnosis of an atypical parkinsonism syndrome is further reduced by consensus agreement on the presence of any two of a marked response to levodopa, asymmetry of signs, asymmetry at onset, or initial onset tremor, signs generally thought to be more specific for PD. Incidence of PD in the Honolulu Heart Program is also in general agreement with rates observed in Europe and the United States.^{25,29} In addition, among the men with PD, 10 cases had an autopsy. Seven cases were confirmed by the presence of Lewy bodies in the substantia nigra, while pathologic examination of the remaining three has not been completed.

Although bowel movement and constipation questionnaires vary among study samples, frequency of bowel movements and use of laxatives in the men in the Honolulu Heart Program are also similar to frequencies described elsewhere.³⁰⁻³⁵ In the National Health Interview Survey on Digestive Diseases, 64% reported having 7 to 13 bowel movements/week and 11.7% reported having 14 to 20/week.³⁰ Although use of laxatives in this cohort was less than in the Honolulu Heart Program, it was not markedly less (increasing from 7.4% in men aged 50 to 59 years to 19.3% in men aged 70 to 79). In the National Health and Nutrition Examination Survey, 64 to 74% recorded daily defecation.³¹ In an industrial community, 5.1% reported having <5 bowel movements/week, 68% reported having 5 to 7/week, and 26% reported having 2/day.³² The latter corresponds well with the 25.1% of men in the current cohort who reported having 2 bowel movements/day, although laxative use in this industrial community was high (27.9% in subjects aged 50 to 59 years to 50% in those who were older). In one report in which bowel movement frequency was recorded in the same manner as in the current sample, 58.9% reported having 1 bowel movement/day, approximately 30% had 2/day, with the remaining sample being evenly divided between those with <1 and >2/day.³³ Use of laxatives was also reported by 18.5% of the sample, similar to the Honolulu cohort.

As might be expected, men in the Honolulu Heart Program also reported using a variety of different types of laxatives. Preference for a specific laxative, however,

Table 4 Estimated relative risk of PD in men with <1 bowel movement/day versus men whose bowel movements were more frequent

Adjustment	Risk of PD in men with <1 bowel movement/d as compared with men with 1, 2, and >2/d		
	1/d	2/d	>2/d
Age-adjusted	2.3‡ (1.2, 4.5)†	3.4§ (1.6, 7.5)	4.8 (1.3, 17.3)
Risk factor adjusted*	2.7 (1.3, 5.5)	4.1** (1.7, 9.6)	4.5†† (1.2, 16.9)

* Adjusted for age, pack-years of cigarette smoking, coffee consumption, laxative use, jogging, and intake of fruits, vegetables, and grains.

† 95% confidence interval.

‡ Excess of PD versus men with 1 bowel movement/d ($p = 0.013$).

§ Excess of PD versus men with 2 bowel movements/d ($p = 0.002$).

|| Excess of PD versus men with >2 bowel movements/d ($p = 0.018$).

|| Excess of PD versus men with 1 bowel movement/d ($p = 0.007$).

** Excess of PD versus men with 2 bowel movements/d ($p = 0.001$).

†† Excess of PD versus men with >2 bowel movements/d ($p = 0.025$).

did not seem to vary greatly by frequency of bowel movements or among cases and non-cases of PD. Among those who used laxatives, approximately 25% were taking milk of magnesia, citrate of magnesia, or magnesium sulfate. Over-the-counter stimulants were used by 12.1% of laxative users whereas 9.2% used prunes, 7.1% used enemas or suppositories, 5.5% used bulk-forming laxatives, and 2.5% used lubricants. Rarely used laxatives included an assortment of fruits, vegetables, cereals, tea, and coffee. Use of laxatives was not associated with the risk of PD.

Although constipation is the most common gastrointestinal disorder among patients with PD, careful comparisons with matched controls are few and equivocal. Variation among reported rates is also high. In four case-control studies, prevalence of constipation ranged from 28 to 61% in patients with PD as compared with 6 to 33% in controls.³⁻⁶ Others report that constipation or prolonged transit time can afflict up to 80% of patients with PD.⁷ Among studies suggesting that constipation can precede PD, one source reported that in a series of 178 patients with PD, 46% had constipation prior to the first symptoms of PD, whereas in spouse controls (largely women), 28% had complaints of constipation.¹ In another study, constipation was reported to have occurred prior to a diagnosis of PD in 10 of 12 patients by an average of 16 years.² In the Honolulu cohort, among the men with infrequent bowel movements (<1/day) who later developed PD, onset occurred an average of 10 years into follow-up (range: 5 months to 19 years).

Despite a history of documentation of an association between constipation and PD since first described by James Parkinson in 1817,³⁶ pathologic mechanisms relating constipation and PD remain poorly understood. Increased colonic transit time may be a manifestation of the same processes that cause the motor symptoms of PD. Evidence supporting this includes the findings of depletion of dopamine-producing neurons in the colon and the presence of Lewy-bodies in the myenteric plexus.^{8,9} Importantly, delayed colonic transport in PD has been found to be independent of age, physical activity, and medication.¹⁰ Additionally, CNS derangements may lead to abnormalities in skeletal muscle of the pelvic floor and anal sphincter that control defecation. Evidence for this includes radiologic studies in patients with PD demonstrating paradoxical anal sphincter muscle contraction during defecation and anorectal manometry showing hypercontractility of the external sphincter.^{4,8,11,12} As a result, it appears that both autonomic and CNS abnormalities contribute to constipation in PD, and it is possible that these changes may be prodromal symptoms of the impending extrapyramidal syndrome.

Effects of diet and physical activity on gastrointestinal symptomatology and PD may also exist, although none has been clearly identified.^{8,13,14} In one report based on 19 patients with PD, dietary intake of insoluble fiber was associated with improvements

in constipation, extrapyramidal function, and bioavailability of levodopa.¹⁵ In the current study, adjustments for jogging and intake of fruits, vegetables, and grains had no effect on the association between bowel movement frequency and the risk of PD. Although not measured when the frequency of bowel movements was first assessed, adjustment for the overall physical activity index²³ that was measured at the time of study enrollment (1965 to 1967) also failed to alter the observed relation between bowel movement frequency and PD in the Honolulu sample.

As noted by others and confirmed here, defecatory dysfunction can precede the clinical diagnosis of PD, suggesting that constipation could be one of the earliest features of PD processes that predate motor symptomatology by an average of 10 years or longer.² Defecatory dysfunction is also thought to be associated with severity and duration of PD,⁸ although such a relation has not been confirmed.¹⁶ It has further been suggested that frequent and severe constipation that is resistant to therapy could be a symptom of the early signs of PD, although a careful distinction must be made from constipation that occurs naturally with advancing age.^{1,6,7}

Failure for constipation to be relieved by laxatives could be a marker of autonomic dysfunction that precedes PD pathology, or it could be a sign that PD processes have already begun. Although data in the current report are too limited to examine constipation that is not relieved by laxatives, the risk of PD appeared highest (26.6/10,000 person-years) in the cohort of men who reported using laxatives and continued to have <1 bowel movement/day. Insufficient data also prevent a clear assessment of interaction effects between frequency of bowel movements and use of laxatives.

It may also be that bowel movement frequency in the elderly has a weaker association with future PD compared with those who are younger, simply because infrequent bowel movements in the elderly become common relative to the incidence of PD. Unfortunately, repeat measurement of bowel movement frequency in the Honolulu cohort did not occur until late into the 24-year follow-up (1991 to 1993). Although bowel movement frequency declined over this period (simply because of the effects of age), bowel movement frequencies reported at the baseline and the later examination were positively related ($p < 0.001$). Using data from the later examination (1991 to 1993), future PD continued to be elevated in men with <1 bowel movement/day. In 3,397 men (aged 71 to 93 years) without PD in whom repeated bowel movement data were available, incident PD was observed in nine men. Among those who reported having <1 bowel movement/day, 1% developed PD (2/223) whereas 0.2% (7/3174) developed PD in those whose bowel movements were more frequent. Although far from conclusive based on the small number of cases, additional follow-up of this sample is expected to improve the opportunity to

more carefully assess the association between bowel movements and the future risk of PD in this elderly sample of men. In addition, the effects of infrequent bowel movements (<1/day) that may have appeared at the baseline examination (1971 to 1974) and persisted until the later examination (1991 to 1993) can also be examined.

In terms of clinical implications in the elderly, demonstration that the association between bowel movement frequency and the risk of PD weakens with advancing age means that information on bowel movement frequency must be measured as early in life as possible. The use of more comprehensive instruments for the collection of constipation histories may also be warranted. Although clinical implications must be defined, combining information on constipation with other factors, such as a positive family history and other motor deficits, could have some uses for identifying high-risk individuals for future PD. It may be worthwhile to document constipation histories from the suspected appearance of PD to its clear clinical presence. Combining constipation that is resistant to therapy with other factors could also provide a means for broadening enrollment into neuroprotective trials by including high-risk groups of asymptomatic individuals with early motor symptomatology.

In light of the observed findings from the Honolulu Heart Program and elsewhere,¹⁻¹⁷ it remains to be determined whether constipation is related to the underlying pathophysiologic processes in PD development, is a sign of early PD, or is a disease marker linked to other susceptibility or environmental factors. Identifying constipation as a risk factor for PD could lead to more effective strategies for identifying early or suspected disease and could provide for opportunities for prevention and intervention.

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Time trends in the incidence of parkinsonism in Olmsted County, Minnesota

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Article abstract—*Objective:* To investigate time trends in the incidence of parkinsonism and PD over a 15-year period (1976 to 1990). *Methods:* The authors used the medical records–linkage system of the Rochester Epidemiology Project to identify incidence cases of parkinsonism in Olmsted County, MN, over three 5-year periods, 1976 to 1980, 1981 to 1985, and 1986 to 1990. PD and other types of parkinsonism were classified using defined criteria. Population denominators were derived from census data and were corrected by removing prevalent cases of parkinsonism. *Results:* Over the 15 years of the study, 364 cases of parkinsonism were identified; 154 (42%) of them had PD. The incidence of parkinsonism remained stable over the three 5-year periods for the age classes 0 to 39, 40 to 59, and 60 to 69 years. For the age class 70 to 99 years, there was some increase over time mainly owing to an increased incidence of drug-induced parkinsonism. The incidence of PD remained stable over the three 5-year periods for all age classes. Results were similar when considering men and women separately. No birth-cohort effect was present for parkinsonism. Comparison with three previous studies in the same population did not reveal any major long-term secular trends in the incidence of parkinsonism. *Conclusions:* The findings for PD over 15 years and comparison of the findings with historical data for parkinsonism over half a century suggest that no major environmental risk factors for PD (e.g., environmental toxins, drugs, diet constituents, or infectious agents) were introduced or removed from this population during these periods.

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The independent role of susceptibility genes and environmental risk factors and their interactions in the etiology of PD remain controversial.^{1–3} Time trends in the incidence of PD may contribute to generating new etiologic hypotheses or may serve as a reference against which to test etiologic hypotheses based on laboratory findings (e.g., the recent suggestion that the pesticide rotenone could be an environmental cause of PD).⁴ In addition, time trends in the incidence of PD and parkinsonism have public health uses for projecting the future burden of these disabling conditions and for planning medical services. Unfortunately, data on time trends are limited because it is difficult to measure the incidence of PD over time in a defined population. The limited current data are derived from counts of existing diagnoses obtained through medical record review and physician surveys or from a records-linkage system.^{5–9}

We investigated time trends in the incidence of parkinsonism and PD over three 5-year periods (quinquennia) in Olmsted County, MN. In addition, we explored long-term trends in the incidence of parkinsonism by comparing our findings with those from three previous studies in the same population.^{7–9} This study was made possible by the records-linkage system serving this community and was part of a broader project partly described elsewhere.^{10,11}

Methods. *Case ascertainment.* We ascertained cases of parkinsonism through the records-linkage system of the Rochester Epidemiology Project, which provides the infrastructure for indexing and linking essentially all medical information of the population of Olmsted County, MN.^{12,13} Each provider in the community employs a dossier system (or unit record) whereby all medical information for each individual is accumulated in a single record. Medical diag-

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Frequency of bowel movements and the future risk of Parkinson's disease

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