ings suggest an association between disproportionately high SNF discharge rates of vulnerable patients and existing Medicare payment policies. Although the clinical implications of these discharge patterns are unknown, payment policies should be designed with consideration of the potential for such unintended consequences, and any potential consequences should be mitigated by balancing existing payment structures with incentives to provide optimal patient care.

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All-Cause and Cause-Specific Mortality Among Major League Baseball Players

There has been increasing attention to professional athletes' long-term health. A few studies[1-3] reported lower all-cause mortality among Major League Baseball (MLB) players compared with US males, but only 1 study with a small sample (n = 985) examined specific causes of death and reported largely nonsignificant results.[3] Players in MLB may have lower cause-specific mortality rates because of fitness associated with playing baseball, but other sport-related aspects—injuries, lifestyle habits, or environmental exposures particular to baseball—could adversely affect players' health. We recently found lower mortality rates among MLB players overall and for certain specific causes compared with National Football League players, all of whom had playing careers of 5 years or longer.[4] To better understand risks compared with the general public, we examined mortality rates among MLB players, including specific causes of death and differences by career length and position.

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Methods | Players (N = 16 637) appearing in 1 or more MLB game between 1871 and 2006 in the Lahman Baseball Database (http://www.seanlahman.com) were linked with the National Death Index (NDI). Deaths before electronic NDI data in 1979 (n = 5902), deaths outside the United States (n = 90), players without NDI linkage data (n = 135), and players older than 75 years in 1979 without indication of death by the end of follow-up (n = 59) were excluded. The study was approved by the Harvard T.H. Chan School of Public Health institutional review board. Consent was not required because data collection involved decedents; however, a confidentiality agreement was signed with the NDI before the release of data.

Standardized mortality ratios (SMR) adjusted for age, calendar year, and race/ethnicity were calculated to compare MLB players with other US males using the National Institute for Occupational Safety and Health Life Table Analysis System. The at-risk period started January 1, 1979, or at the MLB debut date, whichever was later, and ended at death or the end of NDI follow-up (December 31, 2013), whichever was first. Analyses were performed between January 2016 and March 2019. For comparisons among MLB players by career length and position, hazard ratios from Cox proportional hazards models were calculated using the same at-risk period definition with age as the time scale, stratified by decade of birth, and adjusted for race/ethnicity and body mass index at playing career debut. SAS, version 9.4 (SAS Institute Inc) was used for the analysis.

Results | Among 10 451 MLB players who debuted from 1906 through 2006, 8262 (79.1%) were white, mean (SD) age at MLB debut was 24.3 (2.6) years, and mean (SD) number of seasons played was 6.0 (4.9). Mean (SD) age at death was 77.1 (12.6) years. Compared with US males, the MLB players had significantly lower mortality rates from all causes (SMR, 0.76; 95% CI, 0.73-0.78) and many underlying cause of death categories except neurodegenerative disease (SMR, 0.96; 95% CI, 0.76-1.20) (**Table 1**). When both underlying and contributing causes

Table 1. Overall and Selected Cause-Specific SMRs Among 10 451 MLB Players and Hazard Ratios per 5 Additional Playing Seasons[a]

Underlying Cause of Death	Observed Deaths, No.	US Male Population Comparison		Hazard Ratio (95% CI)[c]
		Expected Deaths, No.	SMR (95% CI)[b]	
All causes	2917	3861	0.76 (0.73-0.78)	0.97 (0.93-1.00)
Cancer[d]				
All	740	922	0.80 (0.75-0.86)	1.08 (1.01-1.17)
Respiratory tract and intrathoracic organs	190	307	0.62 (0.53-0.71)	1.13 (0.98-1.31)
Digestive tract organs	187	230	0.81 (0.70-0.94)	0.96 (0.82-1.13)
Prostate	103	107	0.96 (0.79-1.17)	1.04 (0.85-1.28)
Blood	107	90	1.19 (0.97-1.44)	1.22 (1.02-1.46)
Lip, oral cavity, and pharynx	19	18	1.06 (0.64-1.65)	1.12 (0.69-1.81)
Skin	16	19	0.83 (0.48-1.35)	1.53 (0.99-2.36)
All cardiovascular diseases[e]	1303	1609	0.81 (0.77-0.85)	0.91 (0.85-0.96)
All respiratory tract diseases[f]	248	373	0.67 (0.59-0.75)	1.06 (0.93-1.21)
All digestive tract diseases[g]	95	136	0.70 (0.56-0.85)	0.79 (0.62-1.01)
All genitourinary tract diseases[h]	49	79	0.62 (0.46-0.82)	0.84 (0.60-1.17)
Neurodegenerative causes[i]	79	82	0.96 (0.76-1.20)	1.17 (0.94-1.45)
Dementia or Alzheimer disease	46	48	0.97 (0.71-1.29)	1.22 (0.92-1.61)
Amyotrophic lateral sclerosis	9	8	1.16 (0.53-2.20)	0.99 (0.49-1.99)
Parkinson disease	24	27	0.90 (0.58-1.34)	1.15 (0.77-1.71)
All injuries[j]	110	167	0.66 (0.54-0.79)	0.88 (0.72-1.09)
Suicide[k]	25	61	0.41 (0.27-0.61)	0.99 (0.66-1.49)
Diabetes[l]	48	89	0.54 (0.40-0.71)	0.90 (0.66-1.24)
All other causes	220	342	0.64 (0.56-0.73)	0.88 (0.76-1.03)

Abbreviations: *ICD-9*, *International Classification of Diseases, Ninth* Revision; *ICD-10, International Statistical Classification of Diseases and Related Health Problems, Tenth Revision*; MLB, Major League Baseball; NDI, National Death Index; SMR, standardized mortality ratio.

[a] Eighty-nine players who died but did not match with the NDI and 8 players whose causes of death were not provided because of state reporting restrictions were censored the day before their death.

[b] Adjusted for age, calendar year (5-year strata), and race/ethnicity (white vs nonwhite) determined from the NDI matches or predicted with Bayesian methods (R, version 3.4; R Core Team) using last name, birth county, and sex for players born in the United States and Puerto Rico and based on last name only for players born elsewhere. Players with predicted probability of 50% or more of being white were considered white. Accuracy against race/ethnicity from NDI was 85%.

[c] Among MLB players per 5 additional playing seasons, adjusted for position, race/ethnicity (white vs nonwhite), body mass index (linear and squared), and age (as time scale) and stratified by decade of birth.

[d] All cancers: *ICD-9* codes 140-208 and 273.3 and *ICD-10* codes C00-C97; respiratory tract and intrathoracic organs: *ICD-9* 160-165 and *ICD-10* C30-C34 and C37-C39; digestive tract organs: *ICD-9* 150-159 and *ICD-10* C15-C26 and C48; prostate: *ICD-9* 185 and *ICD-10* C61; blood (leukemia, lymphoma, and myeloma): *ICD-9* 201-208 and 273.3 and *ICD-10* C81-C96; lip, oral cavity, and pharynx: *ICD-9* 140-149 and *ICD-10* C00-C14; skin (melanoma and other skin cancers): *ICD-9* 172-173 and *ICD-10* C43-C44.

[e] All cardiovascular: *ICD-9* codes 390-459 and *ICD-10* codes G45, I00-I99, M30-M31, R00, and R58.

[f] All respiratory tract: *ICD-9* codes 460-519 and *ICD-10* codes J00-J98, A48.1, and R09.1.

[g] All digestive tract: *ICD-9* codes 520-579 and 040.2 and *ICD-10* codes K00-K92 and R68.2.

[h] All genitourinary tract diseases: *ICD-9* codes 580-629 and *ICD-10* codes N00-N69, N99, and R31.

[i] Neurodegenerative causes: combination of dementia and Alzheimer disease, *ICD-9* codes 290.0-290.3 and 331.0 and *ICD-10* code G30; amyotrophic lateral sclerosis, *ICD-9* 335.2 and *ICD-10* G12.2; Parkinson disease, *ICD-9* 332 and *ICD-10* G20-G21.

[j] All injuries: *ICD-9* codes E800-E899, E900-E949, and E980-E999 and *ICD-10* codes V00-V99, W00-W99, X00-X59, Y10-Y34, Y36, and Y40-Y89.

[k] Suicide: *ICD-9* codes E950-E959 and *ICD-10* codes X60-X84 and Y87.0.

[l] Diabetes: *ICD-9* code 250 and *ICD-10* codes E10-E14.

of death were considered, statistical significance was met in the same way for all mortality categories. Longer career length was associated with lower all-cause (hazard ratio [HR], 0.97; 95% CI, 0.93-1.00) and cardiovascular-related (HR, 0.91; 95% CI, 0.85-0.96) mortality rates and higher cancer-related mortality rates, particularly lung (HR, 1.13; 95% CI, 0.98-1.31), blood (HR, 1.22; 95% CI, 1.02-1.46), and skin (HR, 1.53; 95% CI, 0.99-2.36) cancers (Table 1). Results were similar when both underlying and contributing causes of death were considered except for digestive tract disease–related mortality (n = 233; HR, 0.94; 95% CI, 0.82-1.09), genitourinary tract–related mortality (n = 279; HR, 0.88; 95% CI, 0.77-1.01), and mortality due to all other causes (n = 83; HR, 0.74; 95% CI, 0.56-0.97).

Compared with pitchers, shortstops and second basemen had lower all-cause (HR, 0.81; 95% CI, 0.72-0.91), cancer-related (HR, 0.78; 95% CI, 0.62-0.98), and respiratory tract disease–related (HR, 0.56; 95% CI, 0.37-0.84) mortality rates; catchers had higher genitourinary tract disease–related mortality rates (HR, 2.52; 95% CI, 1.19-5.35), and outfielders had lower injury-related mortality rates (HR, 0.51; 95% CI, 0.27-0.94) (**Table 2**). Results were similar for underlying and contributing causes of death together except for in cases of shortstop and second basemen cardiovascular-related (n = 249; HR, 0.87; 95% CI, 0.75-1.00) and injury-related (n = 19; HR, 0.59; 95% CI, 0.36-0.97) mortality rates; there were no significant associations for genitourinary tract–related mortality among

Table 2. Overall and Cause-Specific Mortality Among 10 451 Major League Baseball Players by Position[a]

Underlying Cause of death	Pitchers (n = 5019)		Catchers (n = 920)		First and Third Basemen (n = 1124)		Shortstops and Second Basemen (n = 1308)		Outfielders (n = 1965)		Others (n = 115)[b]	
	No.	HR (95% CI)	No.	HR (95% CI)	No.	HR (95% CI)	No.	HR (95% CI)	No.	HR (95% CI)	No.	HR (95% CI)
All causes[c]	1297	1 [Reference]	302	1.01 (0.89-1.15)	332	0.96 (0.85-1.09)	377	0.81 (0.72-0.91)[d]	549	0.97 (0.87-1.07)	60	0.96 (0.74-1.24)
All cancers	336	1 [Reference]	74	0.95 (0.73-1.23)	82	0.92 (0.72-1.18)	94	0.78 (0.62-0.98)	136	0.90 (0.74-1.10)	18	1.14 (0.70-1.84)
All cardiovascular diseases	541	1 [Reference]	141	1.11 (0.92-1.35)	154	1.06 (0.88-1.27)	177	0.92 (0.77-1.09)	264	1.13 (0.97-1.31)	26	0.97 (0.65-1.44)
All respiratory tract diseases[c]	127	1 [Reference]	25	0.87 (0.56-1.35)	26	0.76 (0.50-1.17)	28	0.56 (0.37-0.84)[d]	41	0.74 (0.52-1.05)	1	0.16 (0.02-1.17)
All digestive tract diseases	43	1 [Reference]	8	0.85 (0.39-1.84)	11	1.05 (0.54-2.05)	10	0.73 (0.36-1.46)	18	1.03 (0.59-1.80)	5	2.06 (0.80-5.28)
All genitourinary tract diseases[e]	19	1 [Reference]	12	2.52 (1.19-5.35)[f]	6	1.20 (0.48-3.03)	5	0.74 (0.27-2.00)	5	0.61 (0.23-1.65)	2	1.86 (0.42-8.20)
Neurodegenerative diseases	33	1 [Reference]	6	0.83 (0.34-2.01)	8	0.84 (0.39-1.83)	12	0.87 (0.44-1.71)	20	1.28 (0.72-2.26)	0	NA
Dementia and Alzheimer disease	16	1 [Reference]	4	1.13 (0.37-3.45)	5	1.07 (0.39-2.93)	9	1.27 (0.54-2.96)	12	1.47 (0.68-3.16)	0	NA
Amyotrophic lateral sclerosis	5	1 [Reference]	1	1.19 (0.13-10.65)	2	1.80 (0.34-9.52)	0	NA	1	0.59 (0.07-5.15)	0	NA
Parkinson disease	12	1 [Reference]	1	0.36 (0.05-2.81)	1	0.27 (0.03-2.09)	3	0.63 (0.18-2.26)	7	1.21 (0.46-3.17)	0	NA
All injuries	60	1 [Reference]	12	1.06 (0.56-1.99)	14	1.00 (0.55-1.79)	11	0.63 (0.33-1.20)	12	0.51 (0.27-0.94)	1	0.46 (0.06-3.34)
Suicide	13	1 [Reference]	0	NA	2	0.60 (0.14-2.69)	3	0.84 (0.24-3.00)	6	1.05 (0.40-2.80)	1	2.04 (0.26-16.19)
Diabetes	22	1 [Reference]	6	0.93 (0.37-2.36)	8	1.29 (0.57-2.90)	4	0.53 (0.18-1.56)	8	0.72 (0.32-1.65)	0	NA
All other causes	103	1 [Reference]	18	0.83 (0.50-1.38)	21	0.77 (0.48-1.24)	33	0.85 (0.57-1.26)	39	0.86 (0.59-1.24)	6	1.16 (0.51-2.68)

Abbreviations: HR, hazard ratio; NA, not applicable.

[a] Adjusted for race/ethnicity (white vs nonwhite), body mass index (linear and squared), career length, and age (as the time scale), and stratified by decade of birth. *International Classification of Diseases, Ninth Revision* and *International Statistical Classification of Diseases and Related Health Problems, Tenth Revision* diagnosis codes as indicated in Table 1 footnote.

[b] Other positions include designated hitter, pinch hitter, and pinch runner.

[c] $P < .05$ from likelihood ratio test of global position variable.

[d] Meets Bonferroni corrected significance at $P = .01$ (all-cause: $P < .001$; respiratory tract: $P = .01$).

[e] $P < .10$ from likelihood ratio test of global position variable.

[f] Meets Bonferroni corrected significance at $P = .02$ (genitourinary tract: $P = .02$).

catchers (n = 34; HR, 1.19; 95% CI, 0.80-1.77) and injury-related mortality among outfielders (n = 32; HR, 0.80; 95% CI, 0.53-1.20). There were no significant differences in neurodegenerative mortality rate by career length or player position.

Discussion | Lower MLB player mortality rates may reflect the healthy worker effect among athletes compared with the general population. Lower mortality rates from some causes among players with longer career length may be associated with the sustained fitness required for or other benefits of longer careers. Higher mortality rates from some cancers deserve attention. Skin cancers may be associated with sun exposure, but cancer-related mortality may be associated with products consumed or chemicals (eg, those used to treat fields). Identifying specific factors associated with increased cancer rates may aid in prevention strategies.

Study limitations include the inability to account directly for physical activity, head injuries, and other environmental or genetic factors. Race/ethnicity was imputed for players still alive in 2013; our imputation had good agreement with race/ethnicity when it was known and was consistent with the racial distribution reported in MLB. Mortality rate differences by position may reflect differences in body habitus (eg, middle infielders being leaner). The possible higher genitourinary tract disease–related mortality rate among catchers deserves exploration because genitourinary tract injuries are common in baseball.[5] Neurodegenerative mortality rates did not vary by position or career length, nor did they differ compared with the general population. These results contrast with reports among American-style football and soccer players, which could in part be associated with differences in head injury rates by sport.[6] The findings suggest that playing in MLB is associated with lower mortality from some diseases, but further exploration of increased cancer rates may be warranted.

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Invited Commentary

Longevity Among Major League Baseball Players—Play Ball!

Major League Baseball (MLB) players represent a unique population of individuals in the United States: a select group of men who possess the athleticism, strength, and acumen to navigate into organized professional baseball at the highest level and who are compensated quite well. What do we know about their health and mortality risks? In this issue of *JAMA Internal Medicine*, Nguyen and colleagues[1] report findings from a retrospective cohort mortality study of men who played Major League Baseball and died between 1979 and 2013, as well as characterize their mortality risk as compared with the US male population across the same time period.

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The major study finding is significant longevity, as MLB players were found to have a rate of death that was only 76% of what is expected in US men. This mortality advantage is likely in part a consequence of the healthy worker effect[2] because players had lower mortality risks for cardiovascular disease, cancer, unintentional injury, and respiratory disease, the 4 leading causes of death in the United States today. These findings are consistent with maintenance of a moderate body mass index (calculated as weight in kilograms divided by height in meters squared), regular exercise, and eating well. The deficit of deaths from injury, most likely from fewer motor vehicle crashes and falls, may speak to the strength, coordination, and sense of balance among professional baseball players. Low overall mortality rates also suggest that these players continued to have access to health care services during their playing career and in retirement.[3]

In contrast with studies of professional football players, who experience concussions and traumatic brain injuries that may lead to neurologic disabilities and death,[4] an elevated risk of death from neurodegenerative causes (eg, dementia, Alzheimer disease, amyotrophic lateral sclerosis, Parkinson disease) was not observed among former professional baseball players. The largest deficit in observed deaths between players and the US population was from suicide; this finding is striking and bears further study. Protective factors against suicide in older white men are connectedness to family, community, and friends, as well as physical health, all of which may be characteristic of baseball players and retirees.[5] A comparison of death rates across playing positions shows that shortstops and second basemen fared best, while catchers fared worst, as found in a previous study,[6] which likely reflects body habitus with elevated deaths from genitourinary diseases.

More can be learned by directly comparing the mortality rates of MLB players with the mortality rates of National Football League players, which in effect is controlling for selection because all are elite athletes. A recent study found that when compared with MLB players, National Football League players had 26% higher mortality overall, twice the cardiovascular disease mortality, and 3 times the mortality from neurodegenerative diseases.[7] Systematic differences in body habitus and head trauma risk could explain these associations.

Modestly elevated mortality risks were found for a few cancers. A nonsignificant elevated risk was observed for leukemia, lymphoma, and myeloma, which adds a bit more

evidence that toxins from artificial playing surfaces may be to blame.[8] A lesser elevated, nonsignificant risk was found for cancers of the lip, oral cavity, and pharynx, which is of interest in light of concerns about tobacco chewing among baseball players. In an effort to address these concerns, MLB stated in 2016 that any player who debuts in 2017 or later will be prohibited from using smokeless tobacco on the field.[3] Death from melanoma and skin cancers were less common in baseball players than in the general population of American men, but rates were elevated among players who had longer careers. In 2015, MLB enacted a skin cancer control program called Play Sun Smart to raise awareness and offer prevention messages and screening to the baseball community.

Although MLB players possess unique characteristics, the study by Nguyen and colleagues[1] offers insights for the broader population of men. Causes of longevity are probably not specific to baseball but are instead specific to lifestyle. Maintaining a proper weight, exercising, and remaining fit are effective in increasing life expectancy, especially if begun at an early age, as was likely the case for these players. The study of occupational groups exposed intensely over a long period of time to factors that may elevate disease risks or decrease them are of value because the results may apply to people having similar exposures but of lesser intensity and duration. As such, results from the current study of professional athletes are consistent with previous studies demonstrating health benefits of physical activity and routine exercise in the general population.[9,10]

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COMMENT & RESPONSE

Unified Approach Needed to Implement Nutrition Support Services

To the Editor We applaud Berkowitz and colleagues' recent Original Investigation[1] and were encouraged that enrollment in a medically tailored meal (MTM) program was associated with fewer hospital admissions and less overall medical spending. We serve as primary care clinicians who care for a small panel of high-need, high-cost Medicaid patients at a clinic in East Baltimore that is located in a food desert. Every day, we witness the harms that food deserts and food insecurity, along with other socioeconomic disparities, inflict on the health of our community. We strongly support adopting a "food as medicine" approach to improve health equity, and we appreciate the work by Berkowitz and colleagues to demonstrate the benefits of MTM for the most vulnerable patients.

The authors highlight that MTM interventions are relatively costly and therefore need to be targeted to individuals who would benefit most, as well as that more research is needed to determine how to identify those patients.[1] In the accompanying commentary, Mozaffarian and colleagues[2] emphasize that nutrition must be incorporated into health care and that a structure should be created to ensure patients are referred to the right program. In our experience, not all patients will require MTM, but they may benefit from less intensive and less costly food interventions. For example, patients with higher functional status or more robust social support, but who are still struggling with food insecurity and malnutrition, might benefit from a simple educational intervention paired with food distribution.

We agree with Berkowitz and colleagues and Mozaffarian and colleagues that incorporating a range of nutrition services, such as MTM, will eventually be an essential component of clinical care and be financially supported by health insurance reimbursements.[3] In addition to further research, clinician advocacy is needed to give a voice to our vulnerable patients and to ensure incorporation of nutrition services into clinical care. In particular, we need to ask our elected representatives at the state and federal levels to pass laws that require reimbursement of MTM and other nutrition support services. Second, we need to advocate for meaningful integration of government agencies and programs to combat the "wrong pockets problem."[4] Ultimately, nutritious food is a right, not a privilege, and access should be coordinated by a cohesive, unified administration.