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Trends in Behavioral Risk Factors Resulting in Premature Death in US from 2000-2015

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ABSTRACT

Several of the leading causes of mortality – heart disease, cancer, diabetes, and stroke – are attributable at least partially to modifiable behavioral risk factors. These behavioral risk factors include smoking, poor diet/physical inactivity, and misuse of alcohol. We examined the trends of seven factors (tobacco smoking, misuse of alcohol, poor diet and physical inactivity, accidents, suicide, illicit use of drugs, and sexual behaviors) over the past 15 years in the United States with respect to avoidable deaths. Our data was extracted from the Centers for Disease Control and Prevention Wonder database. The mortality data utilizes the International Classification of Disease Codes, Tenth Edition, to track causes of death. There were several noteworthy trends in the data. Despite intensified attention to preventive health measures, avoidable deaths related to smoking, obesity (due to poor diet/lack of physical exercise), accidents, and sexually transmitted diseases, have remained relatively constant in the aggregate. In contrast, avoidable deaths attributable to illicit drug use, misuse of alcohol and suicide have dramatically increased. Between the year 2000 and 2015, illicit drug use has increased by more than 150%, misuse of alcohol has increased by more than 35% and suicide by more than 50%. These factors have also increased in varying degrees with respect to age cohorts. Many of the leading causes of mortality in the United States are chronic diseases and have genetic components, but they are also the major lifestyle diseases that trace tangibly to behavioral factors. The prospect for future declines in these diseases will most likely depend on a decrease in modifiable risk factors, media and policy advocacy, environmental interventions, improved education and lifestyle modifications.

INTRODUCTION

Many of the leading causes of mortality in the United States – heart disease, cancer, diabetes, chronic obstructive pulmonary disease and stroke – are chronic diseases with complex and interrelated connections and are attributable at least partially to modifiable risk factors. Some of the risk factors are genetic while others are modifiable and behavioral in nature such as smoking, poor diet/physical inactivity, and misuse of alcohol. Previous studies have demonstrated the adverse effects imposed by these factors on human health (Putzer, 2015; Putzer, 2004; Mokdad, 2004; Putzer, 2003; McGinnis, 1993).

There has been considerable progress regarding the understanding of the causes of chronic diseases (Remington, 2011). Consequently, human lifespans in the United States have been increasing over the past 50 years (NIA, 2015; McKenna, 2010). A female born in 2012 can expect on average to live until 81.2 years of age, while a male born in 2012 can expect on average to live until 76.4 years of age (NCHS, 2014). There are many available interventions that likely have contributed to this increase in longevity such as improvements in medical chronic disease diagnoses and treatments, public health preventive strategies, media and policy advocacy, environmental interventions, and an emphasis on healthy lifestyles (Molinari, 2004; McKenna, 2010; CDC, 2017; AHRQ, 2017; NCI, 2005; Remington, 2005).

Notwithstanding the progress from these advancements and improvements, there are still an estimated one million mortalities in the United States which may be considered premature or avoidable (Putzer, 2015; Keeney, 2008). Many of these avoidable deaths are

attributed to behavioral risk factors such as tobacco smoking, misuse of alcohol, poor diet and physical inactivity which may lead to obesity (Lauby-Secretan, 2016; Bell, 2005; Siedel, 1999). Other factors include accidents (e.g., motor vehicle crashes), illicit use of drugs, risky sexual behaviors which may culminate in sexually transmitted diseases, and suicides (Keeney, 2008; Balia, 2008). Thus, we examined the trends regarding these seven factors over the past 15 years in the United States. Additionally, we stratified these seven factors via age cohorts to discern patterns in the factors and consequent premature mortalities.

METHODS

Our data was extracted from the Centers for Disease Control and Prevention (CDC) Wonder database. The database tracks causes of death within surveillance systems that are based on autopsy report codes known as the International Classification of Diseases, Tenth Edition, (ICD-10). Death certificates report a single underlying cause of mortality. The CDC Wonder data includes data from death certificates for US residents and it is easily accessible to view and examine online.

We calculated avoidable deaths for each behavioral risk factor and for each year from 2000-2015. This was accomplished employing a previously published methodology presented by Keeney in a study in 2008. We also differentiated for each of the seven behavioral risk factors - smoking, obesity, illicit drug use, alcohol misuse, sexually transmitted diseases, accidents and suicides - by age strata (less than one year of age, 1-4 years old, 5-14 years old, 15-24 years old, 25-34 years old, 35-44 years old, 45-54 years old, 55-64 years old, 65-74 years old, 75-84 years old, and greater than 85 years of age).

RESULTS

Table1. *Avoidable Deaths from Behavioral Risk Factors*

Total Avoidable Deaths																
	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
Smoking	341,355	339,046	339,748	337,348	326,717	333,443	322,164	320,243	329,721	320,847	322,160	324,139	325,956	332,424	330,371	340,373
Obesity	434,376	431,547	432,285	428,399	416,813	417,867	409,305	405,570	405,776	400,073	402,461	404,179	407,120	411,778	415,957	425,417
Illicit Drugs	9,398	10,026	12,201	13,502	13,984	15,073	17,619	16,572	15,892	15,430	15,157	16,154	16,869	18,318	20,240	23,742
Alcohol Misuse	56,625	57,707	58,400	59,176	58,960	60,333	60,137	61,000	62,744	62,987	65,515	67,613	69,399	71,728	74,058	77,686
STDs	20,584	20,241	20,219	19,769	19,135	18,824	18,650	18,015	17,151	16,346	15,444	15,121	14,853	14,882	14,632	14,495
Accidents	38,096	38,998	40,578	40,658	41,208	41,819	42,229	41,972	39,478	37,233	37,135	37,567	38,568	38,422	39,068	41,225
Suicide	29,343	30,607	31,645	31,477	32,428	32,629	33,292	34,592	36,030	36,897	38,357	39,508	40,596	41,143	42,769	44,189
Total	929,778	928,172	935,076	930,329	909,246	919,988	903,395	897,964	906,793	889,813	896,230	904,281	913,361	928,695	937,096	967,127

Table I shows total avoidable deaths of each of the seven risk factors. It spans the years 2000-2015.

Table2. *Illicit Drug Use*

Illicit drugs																
	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
< 1	6	4	9	4	4	2	8	6	6	7	8	7	9	9	6	9
1-4	8	10	10	9	11	11	16	19	24	19	19	27	21	16	21	32
5-14	13	13	17	13	21	24	24	31	17	17	26	17	14	13	6	21
15-24	773	895	1,114	1,350	1,499	1,507	1,851	1,807	1,762	1,630	1,654	1,820	1,787	1,869	1,989	2,291
25-34	1,867	1,913	2,246	2,496	2,542	2,819	3,388	3,194	3,165	3,155	3,223	3,656	3,935	4,272	4,998	6,170
35-44	3,725	3,789	4,489	4,621	4,458	4,467	4,935	4,332	3,924	3,559	3,386	3,434	3,552	3,860	4,305	5,156
45-54	2,497	2,792	3,461	3,942	4,211	4,761	5,555	5,140	4,880	4,671	4,419	4,500	4,625	4,781	4,982	5,482
55-64	389	463	664	835	997	1,209	1,504	1,722	1,730	1,974	2,060	2,258	2,446	2,919	3,234	3,715
65-74	71	92	125	159	165	178	225	224	275	280	253	323	372	457	568	722
75-84	30	36	33	42	55	57	78	60	65	77	67	74	76	72	83	95
>85	19	19	33	31	21	38	35	37	44	41	42	38	32	50	48	49
Total	9,398	10,026	12,201	13,502	13,984	15,073	17,619	16,572	15,892	15,430	15,157	16,154	16,869	18,318	20,240	23,742

Table II shows total avoidable deaths as a consequence of illicit drug use. It spans the years 2000-2015. It is stratified by age.

Table3. *Alcohol Misuse*

Alcohol Misuse																
	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
< 1	3	2	1	-	-	-	-	2	1	-	1	-	1	-	-	-
1-4	1	-	2	-	-	-	-	-	-	-	-	2	1	2	1	-
5-14	4	2	3	5	6	2	2	4	2	3	-	1	1	3	-	3
15-24	92	102	100	122	134	146	144	189	183	180	145	168	157	141	136	157
25-34	631	616	577	575	573	521	602	683	763	716	861	866	975	1,064	1,201	1,373
35-44	5,242	5,205	5,078	4,931	4,617	4,519	4,407	4,209	4,241	4,115	4,085	4,066	3,981	4,123	4,272	4,528
45-54	10,303	11,147	11,188	11,672	11,816	12,086	12,287	12,594	12,835	13,028	13,316	13,616	13,506	13,281	13,256	13,517
55-64	10,753	10,880	11,527	12,123	12,468	13,284	13,707	14,471	15,221	15,903	17,022	18,220	19,068	20,001	21,138	22,081
65-74	11,956	11,950	11,731	11,655	11,472	11,458	11,253	11,479	11,939	11,922	12,504	12,788	13,724	14,778	15,629	16,891
75-84	11,104	11,238	11,465	11,350	11,206	11,364	11,074	10,720	10,644	10,394	10,499	10,575	10,630	10,750	10,882	11,285
>85	6,536	6,565	6,729	6,744	6,668	6,953	6,661	6,649	6,914	6,727	7,081	7,310	7,356	7,585	7,544	7,851
Total	56,625	57,707	58,400	59,176	58,960	60,333	60,137	61,000	62,744	62,987	65,515	67,613	69,399	71,728	74,058	77,686

Table III shows total avoidable deaths as a consequence of the misuse of alcohol. It spans the years 2000-2015. It is stratified into cohorts based on age.

Table4. *Suicide*

Suicide																
	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
< 1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
1-4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
5-14	307	279	264	250	285	272	219	184	222	265	274	287	311	395	428	413
15-24	3,994	3,971	4,010	3,988	4,316	4,212	4,189	4,140	4,298	4,371	4,600	4,822	4,872	4,878	5,079	5,491
25-34	4,792	5,070	5,046	5,065	5,074	4,990	4,985	5,278	5,300	5,320	5,735	6,100	6,216	6,348	6,569	6,947
35-44	6,562	6,635	6,851	6,602	6,638	6,550	6,591	6,722	6,703	6,677	6,571	6,599	6,758	6,551	6,706	6,936
45-54	5,437	5,942	6,308	6,481	6,906	6,991	7,426	7,778	8,287	8,598	8,799	8,858	8,862	8,621	8,767	8,751
55-64	2,945	3,317	3,618	3,843	4,011	4,210	4,583	5,069	5,465	5,808	6,384	6,521	6,929	7,135	7,527	7,739
65-74	2,292	2,432	2,463	2,335	2,279	2,344	2,384	2,444	2,796	2,917	2,974	3,179	3,367	3,794	4,110	4,201
75-84	2,181	2,192	2,259	2,115	2,120	2,200	2,075	2,119	2,108	2,063	2,052	2,174	2,232	2,300	2,391	2,489
>85	833	769	826	798	799	860	840	858	851	878	968	968	1,049	1,121	1,192	1,222
Total	29,343	30,607	31,645	31,477	32,428	32,629	33,292	34,592	36,030	36,897	38,357	39,508	40,596	41,143	42,769	44,189

Table IV shows total avoidable deaths as a consequence of the misuse of alcohol. It spans the years 2000-2015. It is stratified by age.

DISCUSSION

McGinnis and Foege's (1993) original paper calculated the main external contributors to death. In 2004, Mokdad et al. updated the results and showed an increase in some contributors such as physical inactivity and poor diet. A study completed by Keeney (2008) demonstrated that personal choices affect mortality rates and he found through analysis that one million deaths could be attributable to personal decisions that could have been avoided if readily available alternative choices were made. We extended Keeney's work with a study in 2015 which showed the economic costs associated with lifestyle behaviors and the resulting premature mortalities (Putzer, 2015). A premature death may be defined as when an individual dies sooner than what would have been the case if a different choice had been made (Keeney, 2008; Putzer, 2015).

Despite intensified attention to public health preventive measures over the past 15 years, avoidable deaths due to smoking, obesity (due to poor diet/lack of physical exercise), accidents, and sexually transmitted diseases have not decreased in a sustained significant way. In contrast, avoidable deaths attributable to illicit drug use, misuse of alcohol and suicide have dramatically increased over this duration. Between the year 2000 and 2015, illicit drug use has increased by more than 150% (from 9,398 deaths to 23,742), misuse of alcohol has increased by more than 35% (from 56,625 deaths to 77,686), and suicide by more than 50% (from 29,343 deaths to 44,189).

The increase in illicit drug use and consequent premature mortalities was found across all age groups. The increase in aggregate numbers over the 15 year span is largest among the 25-34 age cohort (1,867 to 6,170), while in percentage terms it is most abundant among 55-64 (over 850%) and 65-74 (over 900%) age cohorts, respectively. The increase in illicit drug use is plausibly related to the opioid abuse epidemic affecting the United States. Moreover, researchers at the CDC recently suggested that opioid deaths may be higher than reported because opioids suppress the body's immune system and can result in being classified on a death certificate as an infectious mortality (CDC, 2017). Opioids affect an individual's respiratory system causing breathing to be slow and shallow thereby diminishing the cough reflex and increasing the chance of pneumonia.

The increase in suicide rates and consequent premature mortalities was present across all age groups. The increase in aggregate numbers over the 15 year span is large among the 45-54 age cohort (5,437 to 8,751) and the 55-64 age cohort (2,945 to 7,739), while in percentage terms it is most abundant among 55-64 (over 160%) age cohort. The increase in suicide may be related to the economic difficulties encountered among this age group during the Great Recession of 2007-2009. Many middle-aged individuals (45-64 years of age) became unemployed with few economic opportunities available to pursue. Moreover, the majority of US citizens have very limited financial savings to withdraw upon during a crisis of any kind (AP-NORC, 2017). Furthermore, at the turn of the century the suicide rate may have been lower due to Surgeon General Dr. David Satcher's Call to Action regarding suicide and the consequent public health emphasis on reducing the number of suicides (NIH, 1999).

There are a few limitations in our study. It is often challenging to track causes of death within surveillance systems that are based on autopsy report codes known as ICD-10. Death

certificates report a single underlying cause of mortality and there may be several co-morbidities which affected the health status and led to the eventual death of an individual. Another limitation is that chronic diseases and causes of death associated with behavioral risk factors may also have a genetic component; thus, complicating the cause of mortality.

Future studies could examine these factors via other socio-cultural and socio-economic means (e.g., gender, ethnicity) to further elucidate the relations between behavioral factors and the leading causes of mortality. Many of the leading causes of mortality in the United States are chronic diseases and have genetic components, but they are also major lifestyle diseases that trace tangibly to behavioral factors. The prospect for future declines in these diseases will most likely depend on a decrease in modifiable risk factors, media and policy advocacy, environmental interventions, improved education and lifestyle modifications.

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