The purpose of this paper is to address the following question: Are Americans today healthier as well as longer-lived? More generally the question can be stated, when mortality declines are concentrated among the older population, does the health of the surviving population improve or is there an increase in the proportion of the surviving population with poor health and/or disabling conditions? In trying to determine the answer to these questions five topics will be briefly addressed: first, the way in which current mortality decline differs from the past; second, why this change is important for the mortality/morbidity relationship; third, what answer to our question do theoretical approaches imply; four, why the answer is more complicated than it seems at first; and finally, what is the empirical evidence on changing health among older Americans over the past two decades.

The Changing Pattern of Mortality Decline

The importance of determining the relationship between mortality change and morbidity change arises from the fact that in the U.S. we have experienced a mortality decline in recent years that is unlike any past period of mortality decline because it has been concentrated among the older population. From 1900 to 1968 only about 15 percent of the total increase in expectation of life was due to reduced death rates in the population over 65. After 1968, over half the improvement in life expectancy occurred at age 65 or above. The absolute improvement in life expectancy at age 65 over the past 20 years comes close to the level of gain in the preceding 70 years.

The reason for this change in the age at which mortality improvement is concentrated can be found in analysis of the mortality decline by cause. From 1900 through the 1950s mortality decline was due to reduction in death rates from infectious diseases. Since 1968 mortality decline has been due primarily to the reduction of chronic diseases especially heart disease. The concentration of mortality decline among these chronic conditions and the projection that it will continue into the foreseeable future is the source of the new concern about the mortality-morbidity relationship.

Until recently most health experts and policy makers assumed that mortality and morbidity would change together. That is, when mortality increased it was because morbidity or sickness had increased and when mortality declined, it was because sickness or morbidity had decreased. For instance, the relationship between mortality change and morbidity change depends on whether the declining mortality should be accompanied by improvement in health in the surviving population or is there an increase in the morbidity. Fries believes that the incidence of chronic diseases, it is not clear that the improvement in morbidity should be accompanied by improvement in health in the surviving population because people are rarely cured of chronic disease. The relationship between mortality change and morbidity change depends on whether the declining death rates are due to a declining incidence or case fatality rate.

The Mortality/Morbidity Relationship When Chronic Diseases Predominate

A number of researchers have hypothesized the direction of the relationship between mortality change and morbidity change when mortality change is dominated by chronic diseases. Fries is perhaps most responsible for the idea that improved mortality will be accompanied by lower morbidity and certainly for terming this occurrence the "compression of morbidity". He expects that the "rectangularization of the survival curve will be accompanied by rectangularization of the curve showing the age of onset of chronic disease". This means that as mortality declines the age of onset of morbidity will both be delayed to later ages and compressed into a shorter period of time at the end of life. Using the terminology of the preceding section, Fries believes that the incidence of chronic disease has and will be reduced as mortality from chronic diseases declines.

Implications of the Changing Pattern of Mortality Decline for the Relationship Between Mortality and Morbidity

As noted above, until recently most mortality decline was due to a decrease in infectious diseases. Over the long run deaths were reduced from these diseases because the incidence of the diseases and/or the case fatality rates were decreased. For instance, the improvement in sanitary conditions reduced the incidence of gastrointestinal diseases and vaccination and immunization reduced the incidence of a number of childhood diseases. The case fatality rate of any number of infectious diseases was reduced with the development and use of sulfa drugs and antibiotics. In either case the population was healthier after a mortality decline because either fewer people got the disease or more of the appearing cases were cured.

When mortality decline is due to reduced death rates from chronic diseases, it is not clear that the improvement in mortality should be accompanied by improvement in health in the surviving population because people are rarely cured of chronic disease. The relationship between mortality change and morbidity change depends on whether the declining death rates are due to a declining incidence or case fatality rate.

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chronic disease is being prevented, they feel that the lowered
mortality rates are not the result of either a reduced incidence
of chronic disease or a reduction in the rate of disease progress-
ion but of reductions in deaths from what they call the "lethal
sequelae" of these conditions. Thus, they believe that the case
fatality rate has decreased but that this has occurred at an
advanced stage of disease progression so that it has resulted
in an unhealthier population.

Manton\(^4\) has proposed a position somewhere between the two
outlined above. He describes the relationship between mortal-
ity and morbidity when life expectancy is increasing as "dy-
namic equilibrium". This means that the "severity and rate
of progression of chronic disease are directly related to mortality
changes so that, correlated with mortality reduction, there is
a corresponding reduction in the rate of progression of the
"aging" of the vital organ systems of the body". Manton seems
to accept the idea of Fries that mortality decline may be
accompanied by decline in incidence of some diseases but he
feels like Kramer and Gruenberg that the bulk of the recent
mortality decline was due to decreases in the case fatality rate.
Manton, however, feels that the reduced mortality has been
due to saved lives at earlier stages of disease progression than
Kramer and Gruenberg. This leads Manton to expect that mor-

tality decline will be accompanied by increasing prevalence but
decreased severity of chronic disease within age groups.

To sum up these three views we turn to the basic epidemi-
ological equation which views morbidity prevalence or how
much sickness exists at a point in time as a function of inci-
dence and duration of illness. The implications of the three
theoretical approaches for the relationships between mortality
decline on measures of incidence, prevalence, and duration of
morbidity are shown in Table 1. Manton's idea that duration
be separated into two ways of increasing duration — elimi-
nating the lethal consequences and decreasing the rate of
progression of the disease — is included for clarity.

Table 1
Three Theoretical Views as to the Direction of Morbidity
Change with Recent Mortality Change in the U.S.

<table>
<thead>
<tr>
<th></th>
<th>Prevalence</th>
<th>Incidence</th>
<th>Rate of Progression</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Duration</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fries</td>
<td>↓</td>
<td>↓</td>
<td>=</td>
</tr>
<tr>
<td>Gruenberg, Kramer</td>
<td>↑</td>
<td>=</td>
<td>↓</td>
</tr>
<tr>
<td>Manton</td>
<td>↑</td>
<td>=</td>
<td>↓</td>
</tr>
</tbody>
</table>

*↓ in sequelae or rate of progression is ↑ in duration.

Two of the views described above lead to expectations of
increased prevalence of morbidity or sickness in the popula-
tion when mortality declines from chronic conditions. One
leads to an expectation of less morbidity in a longer-lived
population. Lower prevalence would occur when mortality
decline occurs because disease incidence is reduced, or fewer
people of a given age have developed a disease. Higher prev-
elence exists where incidence is not changed but mortality
declines because diseases are managed and treated so that
they do not progress as rapidly to death. When this happens

Table 2
Type of Chronic Diseases Causing Activity Limitation (%) Among the Community Dwelling Population (65+), 1980

<table>
<thead>
<tr>
<th>Age Group</th>
<th>Males</th>
<th>Females</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>65-74</td>
<td>75-84</td>
</tr>
<tr>
<td>Killer Diseases(^1)</td>
<td>27.1</td>
<td>27.4</td>
</tr>
<tr>
<td>Non-Killer Diseases(^2)</td>
<td>18.7</td>
<td>26.2</td>
</tr>
<tr>
<td>Total</td>
<td>45.8</td>
<td>53.6</td>
</tr>
</tbody>
</table>

1 Killer Diseases — heart disease, arteriosclerosis, influenza and pneumonia, malignant neoplasms, cerebrovascular conditions, diabetes, bronchitis and emphysema, cirrhosis, nephritis and nephrosis, etc.

Number represents percent of age group whose major cause of activity limitation is among these diseases.

2 Non-Killer Diseases — arthritis, musculoskeletal impairments, vision and hearing loss, mental conditions, paralysis, "senility", etc.

Table 2 shows the percent of older people limited in activity in 1980 by age and by whether the major cause of limitation is a killer or non-killer disease. Overall, killer and non-killer dis-

tases are about equal in causing activity limitation among the old. Killer diseases, of which heart disease is the most impor-
tant, are a relatively larger cause of health problems among the young old (65 to 74) than among the old-old (85+). As people get older, the non-killer diseases, among which arthri-
tis is the most important, become a relatively larger cause of health problems. Because such a significant proportion of poor
health is caused by non-lethal causes, there is no reason to
eXpect that changes in mortality and morbidity will be as
closely related as the three scenarios outlined in Table 1 suggest.
The second reason that the relationship between mortality change and morbidity change is more complex than originally thought has to do with the composition of the surviving population. As mortality declines, those saved from death do not tend to be persons of average constitution but a weaker and frailer group who would have perished under a more severe mortality regime.\(^5\) Thus, with mortality decline the population becomes more heavily weighted with a frailer group more susceptible to a whole host of diseases and conditions than the average survivor in the population. The theoretical arguments presented above ignore the interactive process between diseases and conditions and their effects on population composition.

Empirical Evidence on Morbidity Change in Recent Years in the U.S.

Now we turn to the empirical evidence on health change among the older population in recent years. While debate exists on the acceptability of various pieces of evidence, we will review what we know about the prevalence, incidence, and duration of ill-health in general among the national population. One of the reasons that such divergent views about trends in health have existed is that the evidence needed to satisfactorily document the trend in morbidity in recent years is lacking. In fact, because of changes in national survey practices, the only period for which comparable data exist for the whole U.S. older population are 1969 to 1981. For this reason, we will be confined to evidence for this period.

Prevalence of health problems which affect the performance of everyday activities has been measured in ongoing national surveys. Verbrugge\(^6\) concludes that most work points toward worsening health among the adult population. Guralnik and Schneider\(^7\), however, examining the results for studies concentrating on the older population conclude there may be some increased prevalence of ill-health among the old but that it is also possible that there has been no change. There is virtually no support in the literature for the idea that the prevalence of ill-health has declined.

The prevalence of activity limitation among the older U.S. population is shown in Table 3 for two dates. The figures indicate that there was some worsening of health among the younger old but not the older-old. Most researchers have resisted drawing strong conclusions about worsening or stable health from data like these because they are based on survey responses and there is some skepticism about accepting these as adequate indicators of the trend in health. The skepticism arises from a sense that people may have changed their definitions of health over time because the standards for good health could have risen or the aches and pains of old age may be steadily being redefined as illness. It is also possible that as people have more contact with medical care they are diagnosed as having diseases more frequently and feel justified in limiting activity. For instance, most people do not know they have hypertension unless they have had a blood-pressure test. While certainly there is room for some reservation in drawing conclusions about the trend in health, there is no empirical support for the idea that the prevalence of ill-health has declined among the older population and there is mounting evidence that if change exists it is toward some increasing prevalence.

While the information on incidence and duration is even less clearly known than that on prevalence, it appears that age-specific incidence of long-term disability is not changing in any systematic way while the duration of disability is increasing (Tables 4 and 5). Overall, males in the community dwelling population reported that they had had a long-term disability for about 11 months longer in 1980 than in 1970. For females the increase in duration of illness was only about half as great.

### Table 4
Incidence (per 1000) of Activity Limitation: 1970, 1980

<table>
<thead>
<tr>
<th></th>
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</thead>
<tbody>
<tr>
<td></td>
<td>Males</td>
<td>Females</td>
<td>Males</td>
<td>Females</td>
</tr>
<tr>
<td>65-74</td>
<td>12.0</td>
<td>90.9</td>
<td>88.4</td>
<td>97.0</td>
</tr>
<tr>
<td>75-84</td>
<td>135.5</td>
<td>115.3</td>
<td>142.5</td>
<td>153.4</td>
</tr>
<tr>
<td>85+</td>
<td>133.9</td>
<td>159.5</td>
<td>240.2</td>
<td>241.6</td>
</tr>
</tbody>
</table>

Limitation with onset in last 18 months per 1000 of the population without limitation 18 months before interview


### Table 5
Duration of Limitation (in Months)

<table>
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<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Males</td>
<td>Females</td>
<td>Males</td>
<td>Females</td>
<td>Males</td>
<td>Females</td>
</tr>
<tr>
<td>65-74</td>
<td>88</td>
<td>104</td>
<td>16</td>
<td>88</td>
<td>97</td>
<td>9</td>
</tr>
<tr>
<td>75-84</td>
<td>108</td>
<td>112</td>
<td>4</td>
<td>81</td>
<td>86</td>
<td>5</td>
</tr>
<tr>
<td>85+</td>
<td>111</td>
<td>136</td>
<td>25</td>
<td>91</td>
<td>91</td>
<td>0</td>
</tr>
</tbody>
</table>

Our data thus tends to reinforce the notion of change in morbidity between 1970 and 1980 somewhat along the lines proposed by Manton, perhaps some increase in prevalence of ill-health due to increasing duration of disease and not much change in incidence. We also find support for his idea that any increase in prevalence would be at a less severe level of disability. Among the young old, where prevalence of ill-health increased, the increase was not in days spent in bed but in days with less severe health impairments.8

**Summary and Conclusions**

Our findings would lead us to conclude that to date the dramatic mortality change among the older population has been related to little change in the overall health status of the surviving population. Undoubtedly, this results from the fact that we have accomplished little in the way of preventing the diseases of old-age. While we have made significant strides in preventing death from some diseases, the fact that the older population does not appear even more debilitated after this mortality change indicates that we have probably also prevented the progression of these diseases with the same techniques that prevented mortality. There is no suggestion of a significant increase in the proportion of severely disabled older people. This leads us to reject the notion that our advances in preventing mortality were only delaying death in those already severely debilitated.

The relationship between mortality change and morbidity change may be different in the future when lifestyles, drugs, and technologies allow us to prevent as well as manage disease. However, because such a significant portion of ill-health in old-age is due to diseases that are not killers, we should not expect a close association between mortality change and morbidity change, even in the future. Our investigations of health among the older population have shown that until some of the non-killer diseases are also prevented and/or managed more successfully, there will be very significant ill-health even among an increasingly longer-lived population.

**REFERENCES**