Investigating explanations of socio-economic inequalities in health

The Dutch GLOBE study

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Background: The GLOBE study is a prospective cohort study specifically aimed at the explanation of socio-economic inequalities in health in the Netherlands. The returns of the study are reviewed after ten years of follow-up, and the studies’ contribution to the development of policy measures to reduce inequalities in health in the Netherlands are described. Methods: The study started in 1991 with a baseline postal survey (response rate 70.1% or n=18973, 15–74 years of age). Two sub-samples of respondents to this survey were subsequently interviewed in 1991 (response 79.4% and 72.3%, n=5667). Baseline data collection included measures of socio-economic position, health and possible explanatory factors. Follow-up involved repeated postal surveys and interviews, and routinely collected data on hospital admissions, cancer incidence and mortality by cause of death. Results: Compared with higher socio-economic groups, lower socio-economic groups showed higher prevalence rates of specific conditions (myocardial infarction) and higher rates of all-cause mortality. The higher prevalence of adverse material circumstances, unhealthy behaviour, adverse psychosocial characteristics, and adverse childhood circumstances in the lower socio-economic groups was important in the explanation of socio-economic inequalities in health. Socio-economic differences in health care utilization did not contribute to the explanation. Conclusions: The GLOBE study contributed significantly to the understanding of the explanation of socio-economic inequalities in health in the Netherlands. Study results were a main source of information in the development of policy measures aimed at the reduction of socio-economic inequalities in health in the Netherlands.

Keywords: longitudinal studies, socio-economic inequalities in health, the Netherlands

The publication of the Black Report in 1980,1 in which it was shown that socio-economic inequalities in health in the UK had widened since the 1950s, revitalised research on inequalities in many countries. A systematic search for evidence of inequalities in health in the Netherlands carried out in the late 1980s, confirmed that people at the lower end of the social hierarchy also had higher morbidity and mortality rates than their better-off counterparts.2

At that time, knowledge of explanations of socio-economic inequalities in health was limited. With the primary goal to better understand the background of the health divide,3,4 the Dutch Ministry of Welfare, Public Health and Cultural Affairs launched a five-year national research programme on socio-economic inequalities in health in 1989. As part of this programme, a study was initiated specifically aimed at investigating potential explanations of inequalities in health. It was recognized by the programme committee that this could best be achieved by a large-scale prospective cohort study. Data collection for the study, called the GLOBE study, started in 1991 with a limited budget. With additional finances obtained later, the follow-up period of the study is now approximately ten years.

The specific setting in which the study was initiated, characterized by the recognized need to maximize understanding of the explanation of inequalities in health on the one hand and a limited budget on the other hand, may be similar to current settings in other countries. It is the aim of this paper to review the returns of the study, and to describe its role in developing policies to reduce inequalities in health in the Netherlands.

THE GLOBE STUDY

GLOBE is the Dutch acronym for Health and Living Conditions of the Population of Eindhoven and surroundings. In order to maximize returns of the study, its main aim was formulated broadly (‘investigating explanations of socio-economic inequalities in health’). Based on existing knowledge about (possible) explanations of socio-economic inequalities in health, a rather extensive explanatory framework was developed (figure 1). Within the framework two important mechanisms were distinguished potentially contributing to the explanation of socio-economic inequalities in health: the selection and causation mechanism. The selection mechanism (denoted ①) is represented by an effect of adult health on adult socio-economic position and by an effect of childhood health on adult socio-economic position. The causation mechanism (denoted ②) is represented by four groups of risk factors being potentially intermediary between socio-economic position and health: health related behaviour (e.g. smoking), material circumstances (e.g. physical working conditions), psychosocial factors (e.g. life-events) and health care utilization (e.g. contact with general practitioner). Furthermore, childhood circumstances could influence health at adult ages through the four groups of risk factors and through socio-economic position at adult ages. The need to disentangle selection and causation mechanisms was the major reason for the studies’ prospective design. In 1991, an a-select sample (stratified by age, degree of urbanization and socio-economic position) of 27,070 non-institutionalized Dutch persons (aged 15 to 74 years) was drawn from 18 municipal population registers in the south-eastern Netherlands. With a response rate of 70.1%, baseline information was collected from 18,973 individuals using a postal
questionnaire. Small difference were detected in response rate by socio-economic position, age and gender. \(^5\) Table 1 gives an overview of the most important variables collected at baseline. To obtain more (specific) information, two sub-samples of respondents to the postal survey were additionally interviewed (response rates 79.4% and 72.3%, yielding a total of 5667 respondents). Non-respondents only differed slightly from respondents in one sub-sample, regarding age and marital status.\(^6,7\)

Two procedures were used to obtain follow-up data. First, individuals were interviewed annually in one sub-sample and bi-annually in the other sub-sample. In 1997, people in both sub-samples were asked to fill in a postal questionnaire and were approached for an interview (response 85.8%). Second, the data were linked with national databases, i.e., on hospital admissions, the regional Eindhoven cancer registry and the national register of causes of death, which were then available for the period from 1991 to 1998. Record linkage was possible because the study population was tracked through municipal population registers in and outside the study area from the start of the study. These registers virtually completely cover the population and are maintained continuously with respect to deaths and changes of address. People who moved from the study area were traced through the municipal register of their new place of residence.

**RESULTS**

In cross-sectional analyses using baseline information a higher prevalence of a less than good perceived general health,\(^7\)–\(^12\) health complaints,\(^8\) chronic conditions\(^7\)–\(^9\) and disabilities\(^13\) in the lower compared to the higher socio-economic groups was found. Furthermore, longitudinal analyses in a sub-sample showed that the course of disabilities was less favourable among chronically ill people with a relatively low income.\(^13\) Before the start of the study, information about inequalities in morbidity was predominantly derived from health interview surveys. Record linkage with hospital admission data allowed this association to be investigated with more objective data. There appeared to be an increased risk of the incidence of acute myocardial infarction in the lower compared to the higher educational groups, that we may have even underestimated because we could not include pre-hospital deaths.\(^14,15\) In agreement with other Dutch longitudinal studies with follow-up periods up to the early 1980s, the GLOBE study showed a higher risk of all-cause mortality in lower compared to higher educational groups. Again, there are reasons to suspect an underestimation of the gradient. The socio-economic gradient in all-cause mortality among respondents and non-respondents was compared to the baseline postal survey, using a postcode-based measure of socio-economic position; preliminary analysis suggests that the socio-economic gradient among non-respondents was steeper than among respondents. The overall picture emerging from these findings is that the magnitude of inequalities in

**Table 1** Baseline measurement in the GLOBE study of socio-economic position, health indicators and factors possibly involved in the explanation of socio-economic inequalities in health

<table>
<thead>
<tr>
<th>Socio-economic position</th>
<th>Health indicators</th>
</tr>
</thead>
<tbody>
<tr>
<td>Educational level</td>
<td>Perceived general health</td>
</tr>
<tr>
<td>Occupational level</td>
<td>Nottingham Health Profile</td>
</tr>
<tr>
<td>Income</td>
<td>Subjective health complaints</td>
</tr>
<tr>
<td></td>
<td>Chronic conditions</td>
</tr>
<tr>
<td></td>
<td>Long-term disabilities</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Factors involved in explanation</th>
<th>Material circumstances</th>
</tr>
</thead>
<tbody>
<tr>
<td>Health related behaviour</td>
<td>Financial situation</td>
</tr>
<tr>
<td>Smoking</td>
<td>Labour market position</td>
</tr>
<tr>
<td>Alcohol consumption</td>
<td>Housing conditions</td>
</tr>
<tr>
<td>Physical activity</td>
<td>Neighbourhood conditions</td>
</tr>
<tr>
<td>Body mass index</td>
<td>Physical working conditions</td>
</tr>
<tr>
<td>Personality characteristics</td>
<td>Health care utilization</td>
</tr>
<tr>
<td>Coping styles</td>
<td>General practitioner</td>
</tr>
<tr>
<td>Social support</td>
<td>Medical specialist</td>
</tr>
<tr>
<td>Negative life events</td>
<td>Physiotherapist</td>
</tr>
<tr>
<td>Long lasting difficulties</td>
<td>Hospital admission</td>
</tr>
<tr>
<td></td>
<td>Prescription drugs</td>
</tr>
</tbody>
</table>

**Figure 1** Representation of mechanisms and factors investigated in the GLOBE study
Health in the Netherlands in the past decade is largely similar to inequalities in other Western European countries. The remainder of the results section reviews explanations for these inequalities.

**Health-related behaviour**

From all potential explanations of inequalities in health, the potential role of health-related behaviour was probably best documented at the start of the study. Nevertheless, it was mainly restricted to smoking, nutritional habits and alcohol. Educational differences were found in a number of behaviours that were also adversely related to health and mortality. Smoking, physical inactivity in leisure time, and excessive alcohol consumption were more common in the lower than in the higher educational groups (table 2). Findings for excessive alcohol consumption illustrate the importance of up-to-date descriptive information, because in comparison with earlier findings, the direction of the socio-economic gradient turned round. The average body mass index was also higher in the lower educational groups (table 2).

Most studies including behavioural factors and information about socio-economic position were not designed to assess the contribution of behavioural factors to inequalities in health. The generalisability of findings of studies that could perform such analyses was limited, because the distribution of risk factors over socio-economic groups changed substantially over time. It was found that a substantial part of the health problems in the lower educational groups could be attributed to the higher frequency of unhealthy behaviour in these groups. This was concluded from analyses which compared the educational gradient in mortality, the incidence of acute myocardial infarction, and the prevalence of self-reported health, both before and after adjustment for behavioural factors. This is illustrated for all-cause mortality in table 3.

Because behavioural factors are potentially modifiable, and a reduction of inequalities in health can, to some extent, be realised through the reduction of inequalities in behavioural factors, longitudinal analyses were employed to investigate mechanisms for inequalities in health-related behaviour. These were found to be partly due to a causation mechanism: educational level was clearly related to subsequent changes in health-related behaviour. Between 1991 and 1997, people in lower educational groups more often had continued smoking, reduced the amount of leisure-time physical activity, and more often had started excessive alcohol consumption (Droomers et al., submitted) than people in higher educational groups. No difference could be demonstrated in six-year change in body mass index between educational groups. Studies on the background of inequalities in smoking, physical activity and alcohol intake showed that differences in material factors (such as income) and psychosocial factors (such as the locus of control) contributed to these inequalities.

**Material circumstances**

In the Black Report, differences in material conditions between socio-economic groups were regarded as an important explanation for inequalities in health. Empirical evidence for this explanation in the Netherlands was scarce. In the GLOBE study, a number of material factors adversely related to health and mortality, such as financial problems, having a long term work disability, a low income, complaints about the dwelling.

### Table 2: Baseline prevalence of high-risk categories of factors intermediate in the association between educational level and health, GLOBE study, 1991

<table>
<thead>
<tr>
<th>Factor</th>
<th>High (1)</th>
<th>Educational level</th>
<th>Low (4)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Health-related behaviour</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Smoking ≥20 cigarettes/day</td>
<td>4.5</td>
<td>5.3</td>
<td>7.5</td>
</tr>
<tr>
<td>No leisure time physical activity</td>
<td>2.2</td>
<td>4.0</td>
<td>4.9</td>
</tr>
<tr>
<td>Excessive alcohol consumption, men</td>
<td>11.0</td>
<td>14.0</td>
<td>18.2</td>
</tr>
<tr>
<td>Excessive alcohol consumption, women</td>
<td>1.0</td>
<td>3.7</td>
<td>3.4</td>
</tr>
<tr>
<td>Average body mass index, men</td>
<td>23.4</td>
<td>24.6</td>
<td>25.0</td>
</tr>
<tr>
<td>Average body mass index, women</td>
<td>21.7</td>
<td>23.0</td>
<td>23.4</td>
</tr>
<tr>
<td><strong>Material factors</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Severe financial problems</td>
<td>1.9</td>
<td>2.4</td>
<td>3.3</td>
</tr>
<tr>
<td>Labour market position</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Long-term work disability</td>
<td>2.5</td>
<td>3.7</td>
<td>5.7</td>
</tr>
<tr>
<td>Income proxy</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Rented house, car, public health insurance</td>
<td>8.8</td>
<td>17.3</td>
<td>28.4</td>
</tr>
<tr>
<td>Rented house, no car, public health insurance</td>
<td>5.3</td>
<td>6.0</td>
<td>9.1</td>
</tr>
<tr>
<td>3 complaints about dwelling</td>
<td>0.6</td>
<td>1.2</td>
<td>1.9</td>
</tr>
<tr>
<td><strong>Psychosocial factors</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>High degree of hostility, men</td>
<td>11.2</td>
<td>22.7</td>
<td>29.7</td>
</tr>
<tr>
<td>High degree of hostility, women</td>
<td>15.9</td>
<td>17.8</td>
<td>26.5</td>
</tr>
<tr>
<td>Low perceived control</td>
<td>3.6</td>
<td>10.4</td>
<td>18.8</td>
</tr>
<tr>
<td><strong>Childhood circumstances</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Education mother primary school only</td>
<td>31.5</td>
<td>55.7</td>
<td>69.8</td>
</tr>
<tr>
<td>Father unskilled manual worker</td>
<td>9.0</td>
<td>15.2</td>
<td>27.2</td>
</tr>
<tr>
<td>(Very) often not enough money</td>
<td>2.5</td>
<td>6.9</td>
<td>8.8</td>
</tr>
</tbody>
</table>

a: % standardized for age and gender.
b: (1) higher vocational school and university, (2) intermediate vocational and intermediate/higher general education, (3) lower general and vocational school, (4) primary school.
c: Because income was not available at the individual level for all participants in the GLOBE study, we used a proxy of income, consisting of housing tenure (rented house/house owner), car ownership (yes/no) and type of health insurance (private or public insurance).
(table 2), and adverse physical working conditions appeared to be more common in the lower than in the higher educational groups. Adjusting the educational gradient in mortality, the incidence of acute myocardial infarction, and the prevalence of poor self-reported health, for these adverse material circumstances showed that they contributed to a large extent to the explanation of socio-economic inequalities in health and mortality. This is again illustrated in table 3, using all-cause mortality as health outcome.

Intermezzo: the complexity of explaining inequalities in health
An important component of the complexity of explaining inequalities in health is that explanations are not mutually exclusive. A major strength of our study is its ability to integrate several explanations in one analysis. This is thus far best illustrated by the idea that part of the higher prevalence of unhealthy behaviour in the lower socio-economic groups is likely to be induced by adverse material circumstances. For example, people might smoke to compensate for unfavourable living conditions such as a low income. This implies that the unequal distribution of behavioural factors across socio-economic groups can partly be ascribed to the unequal distribution of material factors. Therefore, also part of the contribution of behavioural factors to the explanation of socio-economic inequalities in health and mortality could be ascribed to the influence of material factors. After quantifying the ‘overlap’ between the contribution of material and behavioural factors, evidence was found of a more important role for the first group of factors in the explanation in inequalities in different health outcomes.

Psychosocial factors
Initial thoughts about a contribution of psychosocial factors to inequalities in health consisted of a differential exposure to stressful living circumstances, such as a poor financial situation, and negative life events and a differential vulnerability to the health impact of stressors, through differences in coping styles.

Table 3 Effect of adjustment for behavioural and material factors on the association between educational level and all-cause mortality, with relative hazard (RH) by educational level and percentage change in RH, 1991–1996, GLOBE study

<table>
<thead>
<tr>
<th>Educational level</th>
<th>Confounders + material factors + behaviour</th>
<th>Independent effect behaviour</th>
<th>Indirect effect material factors (overlap)</th>
<th>Direct effect material factors</th>
</tr>
</thead>
<tbody>
<tr>
<td>High (1)</td>
<td>1.00</td>
<td>1.00</td>
<td>75–46=29%</td>
<td>46–25=21%</td>
</tr>
<tr>
<td>2</td>
<td>1.28</td>
<td>1.15</td>
<td>54–29=25%</td>
<td>48–23=25%</td>
</tr>
<tr>
<td>3</td>
<td>1.25</td>
<td>1.23</td>
<td>77–52=25%</td>
<td>52–23=25%</td>
</tr>
<tr>
<td>Low (4)</td>
<td>1.64</td>
<td>1.21</td>
<td>92–67=25%</td>
<td>67–29=39%</td>
</tr>
</tbody>
</table>

a: Percentage change calculated by (RH model 1) – (RH model 2, 3, or 4)/[RH model 1] – 1.
b: High (1) = higher vocational school and university; (2) intermediate vocational school and intermediate or higher secondary school; (3) lower vocational school and lower secondary school; low (4) = primary school.
c: Model 1 = adjusted for the confounders age, gender, marital status, educational level, and degree of urbanisation.
d: Model 2 = educational level + confounders + alcohol consumption + smoking + body mass index + physical activity.
e: Model 3 = educational level + confounders + financial problems + employment status + income proxy.
f: Model 4 = educational level + confounders + alcohol consumption + smoking + body mass index + physical activity + financial problems + employment status + income proxy.
g: Percentage reduction of relative hazards for educational groups due to inclusion of behavioural factors (model 4) to a model already containing material factors (model 3).
h: Calculated by subtracting the independent effect of behavioural factors from the total effect of behavioural factors (model 2): % model 2 – independent effect of behavioural factors.
i: Calculated by subtracting the overlap from the total effect of material factors: % model 3 – overlap.

Cross-sectional analyses revealed that differential exposure to stressors, but not differential vulnerability to the health impact of stressors contributed to socio-economic inequalities in health. During the period of follow-up, results of other studies increasingly emphasized the role of other psychosocial factors in the explanation of health, in particular, but not exclusively, related to the concept of ‘control’. The 1997 postal survey sent to both sub-samples allowed extension of the psychosocial data collection with information according to these new insights. Indeed, a high level of hostility, low perceived control, and low job control were found to be adversely related to health and mortality and more common in the lower socio-economic groups (table 2). Figure 2 illustrates the effect of adjustment for perceived control on the association between educational level and all-cause mortality.
was affected by health problems. Health problems in 1991 were
however, associated with a higher risk of mobility out of em-
ployment and a lower risk of mobility into employment.33 Mobility
between occupational classes and mobility into and out of the
labour market, were hardly affected by health-related factors
(health-related behaviour, psychological characteristics and
stressors).34 A small part of socio-economic inequalities in
health at adult age could be attributed to the higher prevalence
of health problems in childhood reported by adult people from
lower socio-economic groups.35

DISCUSSION
In a period in which a widening gap in health between those in
lower compared to those in higher socio-economic groups was
reported in other countries,36 this study updated the magnitude
of inequalities in health in the Netherlands and added new
descriptive evidence to it, as, for example, for morbidity. In this
context it is important to mention that record linkages allow
extension of the analyses to other types of morbidity than acute
myocardial infarction; investigations on inequalities in un-
intentional injuries and cancer incidence are now in progress.
Similarly, analyses of inequalities in all-cause mortality are
currently extended to cause-specific mortality.
Perhaps more importantly, by focusing specifically on explana-
tions of inequalities in health, we changed from a situation of
fragmentarily available knowledge to one with a more systematic
and comprehensive overview of the relative importance of
potential explanations of inequalities in health. To some extent,
the study showed that explanations of inequalities in health in
other countries were at least partly similar in the Netherlands.
For example, findings that a substantial part of socio-economic
inequalities in adult health can be attributed to socio-economic
differences in the childhood environment, is in agreement with
findings from some,12–41 though not all,32,44 other available
studies. Results also correspond with studies that showed a
contribution of the psychosocial environment at work to the
explanation of the socio-economic gradient in health.44 For
potential intermediary factors which vary between countries, the
GLOBE study explored their contribution to inequalities
health in the Netherlands. For example, previous studies of
well-defined populations suggest that health care can contribute
to (an improvement of) socio-economic inequalities in health.45–47
In our study, however, health care utilization did not
seem to contribute to an explanation of socio-economic
inequalities in the course of diabetes38 and heart disease.29 This
favourable situation can be accredited to the fact that the access
to the Dutch health care system does not vary between socio-
economic groups. Finally, we were able to add innovative
information to the international debate on explanations of
inequalities in health. As an illustration, it has been shown
that material factors are more important in explaining socio-
economic inequalities in health and mortality than behavioural
factors.8,15,20 The findings imply that previous studies focusing
on the contribution of behavioural risk factors to the
explanation of socio-economic inequalities in mortality
without adjustment for material factors,48–55 may have over-
estimated the independent contribution of behavioural factors,
because part of this contribution may be attributed to material
factors.

Policy recommendations
Recently, the final report of the second 5-year national research
programme on inequalities in health was published and
presented to the now called Ministry of Health, Welfare and
Sports.56 Prior to presenting policy recommendations, the
committee expressed its view on the background of inequalities
in health in the Netherlands in this report. This view was mainly
based on results of the GLOBE study: social causation is regarded
as more important than social selection and in the causation mechanism behavioural, material and psychosocial factors are regarded as important mediating factor between socio-economic position and health. Four key points are then identified by the committee for the reduction of inequalities in health: reduction of

- differences in socio-economic factors,
- the negative impact of health-related problems on socio-economic factors,
- the negative health effects of low socio-economic factors, and
- improving accessibility and effectiveness of health care provided to lower socio-economic groups.

For most of these key points, the GLOBE study provided information for the formulation of policy recommendations. High priority is recommended to the reduction of a number of health-damaging habits among lower socio-economic groups (such as smoking and a lack of physical exercise). Further, the improvement of working conditions for individuals in lower level occupations is recommended. Such improvements should be focused on both hazardous physical and psychosocial (i.e. lack of control) working conditions. According to the committee, differences in utilization of health care services between socio-economic groups are generally not large, as far as the data can be interpreted. It appears that the Dutch system of health care is accessible by individuals of all socio-economic groups. It is emphasized, however, that maintenance of equal access to the health care system for various socio-economic groups in the Netherlands is important.

Limitations of the study
As mentioned earlier, the limited budget for the study forced us to choose a cost-effective study design. As a consequence, the study has a number of methodological limitations. We were forced to collect the majority of the data by postal survey. Consequently, the study population was restricted to persons with Dutch nationality thereby limiting the external validity of the results. Data about psychosocial factors, health care utilization and childhood circumstances could only be collected among members of the sub-cohorts. The contribution of these factors to the explanation of socio-economic inequalities in health could therefore be studied within these sub-cohorts. Because the statistical power of analyses conducted within these sub-cohorts was limited, only common health problems could be studied. We also had to use rather crude measurements of possible explanatory factors. Most information on these factors was obtained by one or a few questions in the 1991 data collection, and as such the life-time exposure of individuals to health damaging factors was neglected. This may have biased estimates of selected health outcomes. Further, it appears that the data on health damaging factors is an overlap between these two groups of factors. Other groups of factors, however, might also overlap, such as psychosocial and behavioural factors and psychosocial and material factors.

In order to be able to assess the exact contribution of explanatory factors to the explanation of socio-economic inequalities in health, we need to perform analyses in which several explanatory factors are integrated. Third, the international debate on the causes of socio-economic inequalities in health has partly evolved around new issues. Thus, we are facing the challenge to continue the study in a way that will allow us to test hypotheses related to these issues. A major issue in this context is the recognition that inequalities in health develop over the life course. Improved evidence of the explanation of inequalities in health should therefore come from studies in which exposure to determinants of health during the entire life-course needs to be measured, and in which causation and selection mechanisms and the interactions between determinants should be investigated. Further, associations were found between both material and psychosocial factors and health. A next step in this area of research would be to unravel the possible mechanisms explaining these associations, such as biological effects of psychosocial factors on health and health effects of material and psychosocial factors that run through behavioural factors. A final issue comes from increasing evidence that living in deprived neighbourhoods affects health, even after taking into account the individual socio-economic position of neighbourhood residents. Due to the high sampling density in the urban part of the population in our sample at baseline, we were recently able to confirm these findings in the Netherlands. A higher all-cause mortality and higher prevalence of obesity was found in more compared to less deprived neighbourhoods, even after taking into account the socio-economic position of the neighbourhood residents. These findings suggest that specific neighbourhood characteristics are involved in the explanation of the association between neighbourhood deprivation and health. Furthermore, neighbourhood characteristics might also be factors intermediate in the association between individual socio-economic position and health, and this mechanism could also be the focus of future research.

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