Physical and Behavioral Responses to Starvation and Famine in Two Populations

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**Introduction**

Famine is an event in which food and resources are inaccessible and the majority of a population is endangered (Shipton, 1990). When applied to starvation this definition is accurate with one additional idea: starvation is the result of inaccessibility to resources. Many factors contribute to the progression of famine and the resulting starvation. One of the key factors to consider is the delineation between naturally occurring and man-made starvation and famine. Naturally occurring famine is the result of agricultural or environmental causes such as lack of rainfall or poor soil conditions. Man-made famine is the deliberate denial of food to people “with the aim of starving them into submission” (De Waal 1991:77). Man-made famine and the resulting starvation will be the basis for this paper.

The purpose of this paper is to examine and compare the physical and behavioral responses to starvation and famine in residents of the Warsaw Ghetto during Nazi occupation and the citizens of famine-prone areas of the West African Sahel region. The location of the two regions discussed can be found on the maps (Figure 1 and Figure 2) at the end of this paper. The connections and contrasts of the two populations will be demonstrated through review and presentation of models from literature, a brief background on the populations to be discussed, examples of the populations as they fit the models and a brief discussion of limitations and opportunity for further study.

**Literature Review: Physical and Behavioral Response Models**

*Physical Response*

The comparison between the Warsaw Ghetto and the West African Sahel region can best be examined through the Biology of Human Starvation study conducted at The University of Minnesota in 1944 and 1945 involving thirty-two voluntary subjects. The study is an evaluation
and analysis of starvation in human subjects and is commonly used for interpreting starvation and famine experiences under less controlled populations and circumstances. The results of the study filled the urgent need after World War II for information on the physical changes that occur because of semi-starvation and what approach should be taken in rehabilitating starving people. The parameters in addition to continuous residence at the Laboratory of Physiological Hygiene at the University of Minnesota included strict dietary controls during the three stages of the study: a twelve-week control, a twenty-four week semi-starvation, and a twelve-week period of restricted rehabilitation. The diet consumed during the semi-starvation period reflected the diet typical of European areas that had or were experiencing famine. The food proportions and diets were adjusted to each subject according to body size and relative obesity (Keys et al., 1950).

Detailed accounts of the physical responses of the subjects and morphology of the body as it underwent nutritional restriction were included in the study. There was an average decrease of twenty-five percent muscle tissue and subcutaneous fat, which caused much of the body to become atrophied. The bones of the upper torso (specifically the clavicle and rib bones) became prominent as soft tissues diminished. Dental caries, an expected response to starvation, increased by an average of one in the subjects involved in the Minnesota study. The subjects at the start of the study had on average 5.6 dental caries per person and their inner-mouth tissue was considered healthy. The increase is relative to people of similar populations not under nutritional stress and so this increase of one cavity indicates little. The skin of the subjects, the easiest organ in which to observe change in became mildly dry and scaly over the course of the study. Because of its controlled parameters, this study serves as an excellent model for the physical response of the human body during semi-starvation.
As an additional perspective, the symptoms of fasting are offered here as a model for an event in which little or no food is consumed. For the purposes of this paper, fasting is the closest state to starvation and famine where food is inadequate in meeting the dietary needs of the individual. Every cell in the body requires energy to function. That energy at the start of a fast is provided by glucose stored in the liver as glycogen and fatty acids. Several hours after the fast begins most of the stored glycogen has been used and blood sugar levels start decreasing. As blood sugar levels decrease, it signals the body to begin breaking down fat and to release amino acids, or stored protein from muscles. Most of the body is now operating off fatty acids, but red blood cells and the brain require glucose to function. For an individual who is fasting or starving, the body begins to furnish the needed glucose through pyruvate, a product of amino acids that are found in muscle and liver tissues. The breaking down of these tissues explains the rapid loss of muscle mass and the atrophy that appears in cases of starvation. A lot of energy is required by the body to endure this process, however, and as body proteins break down the rate at which fat breaks down almost doubles, which provides further energy for the body. As time progresses and needed glucose becomes difficult to produce, the body shifts to ketosis. Ketosis is the process where acetyl CoA fragments, a product of fatty acids, help to produce an alternate energy source. Unfortunately, ketone bodies can only serve some cells of the brain and not those that specifically rely on glucose. Throughout ketosis, the body continues to break down protein at a very slow rate. Ketosis produces a loss of appetite, which benefits a starving person because they no longer feel the need to search for food and waste valuable energy on that search (Whitney and Rolfes, 2005).

*Social Response*
The progression and interaction of physical and behavioral responses is best described by Dirks et al. (1980) who says that when starvation is being experienced by the majority of people in a population, starvation becomes more than a biological phenomenon. Activity, social practices and interaction, culture, and emotional and psychological well-being are all affected and changed at this point. The Minnesota study is a model for these described changes, but will be supplemented by other related literature where appropriate.

Dirks et al. (1980) references a response discussed by Seaton (1962) that hungry groups of people will turn to powerful figures for control and that this control becomes desirable. When applied to the Minnesota study it is also found to be true: at twelve weeks into the semi-starvation period, the subjects were asking for more control to be placed over them. This illustrates one of the primary purposes driving man-made famine: submission of the population and/or victim to the controlling party.

To gather information from the subjects of the Minnesota study on social and psychological experiences, interviews and questionnaires were used. The objective of the inquiry was the same for the behavioral responses as it was for the physiological: to understand the response to semi-starvation. There was a general deterioration during semi-starvation in energy levels resulting in fatigue, appetite resulting in lessened hunger, and morale resulting in depression and periodic feelings of despair (Keys et al., 1950).

The subject’s behavioral responses to semi-starvation changed over the course of the twenty-four weeks. Along with the physical response of being cold due to loss of soft tissues, the subjects made constant requests that the food be served extremely hot as they perceived that if the food was hotter they would draw heat from it and that it was more filling and satiating when warm. The subjects became easily irritated and at times would spend an average of two
hours playing with their food to make it last longer or acting out ritual like behaviors to savor their food. Subjects were also observed adding large quantities of salt to their food and on several occasions were observed licking their plates so as not to waste their ration. Socially the subjects began to withdraw and become aggressive about what was theirs: their place in line and their food. Food became a topic of conversation between the subjects and they sought the topic in the books they read and the films they watched often finding new recipes and making plans for what they were going to do when the study was completed and they returned to their normal lives (Keys et al., 1950).

A second model for behavioral response is described by Shipton (1990) as a series of prevention and remedy strategies. These strategies act as coping methods and although they are discussed in terms of African famine, they are applicable to all populations dealing with food shortage and restriction and are worth mentioning here as further models for behavior responses.

The prevention strategies used when planning for famine are:

1) Diversification of livelihood and resources
2) Consolidation of savings into illiquid, indivisible, or incontestable forms
3) Social investment

The remedy strategies used when responding to famine are:
1) Liquidation: converting inedible capital assets into edible ones
2) Service labor (wage labor and clientage or asymmetric interpersonal dependencies)

Population Background: Warsaw Ghetto and West African Sahel Region

Warsaw Ghetto

Tushnet (1966) provides a concise history of the Warsaw Ghetto and its contribution, the Hunger Project, to medical science. In September of 1939 Warsaw, Poland, a predominately Jewish area was surrendered to the Germans. All residents who were not Jewish were quickly moved and the Jews were quarantined to the poorest area of Warsaw. Food became scarce and
sanitation was poor causing development of starvation and disease. Prisoners in the Warsaw Ghetto received, on average, 300 calories per day. This number varied and declined over time and was influenced by an individual’s status in the community. In November of 1941, the Hunger Project began on the initiative of a group of Jewish doctors living in the Warsaw Ghetto who desired to utilize their unfortunate circumstances to advance medical science while studying the nutrition and health status of their peers. This sort of project, less the recording of it, was risky and in opposition of many Nazi decrees. The project was well orchestrated and charts, tables and data were meticulously gathered. The residents of the Ghetto lived and worked confined there until July 1942 when the mass movement of residents to the extermination camps began. At this same time, the data from The Hunger Project was hidden and the manuscript for publishing was smuggled out of the Warsaw Ghetto. In May 1943, the Ghetto was liquidated with a final mass deportation to the extermination camps. The Warsaw Ghetto represented an unfortunate set of circumstances, however, the contributions made by the Hunger Project and the doctors and residents of the community to medical science are invaluable.

*West African Sahel Region*

In his discussion of famine, Watts (1991) cautions against assuming that all cases of famine are caused by a singular agent. The danger in isolating causes is that often starvation and famine are a result of a combination of factors and such is the case with Ethiopia and other famine prone areas of West Africa (Watts, 1991). In Africa when factors such as faulty agricultural practices, crop failures and changing weather trends are coupled with the preexisting high rate of HIV/AIDS, other diseases and social conflict the risk of famine is increased (WHO, 2002).
Keller (1992) discusses famine in Africa by examining how political decisions in Ethiopia in the 1970s over time intensified an already present drought and eventually lead to famine. In 1974 the Old Order in Ethiopia fell. The Old Order had denied the oncoming famine and the deplorable conditions and mass starvation that most of the country’s people were experiencing. The leadership that replaced the Old Order had no plan and little intention to manage the famine and starvation that would later ensue and had no structure in place to distribute relief aid. As conflict intensified, the government continued to support development and used relief aid intended to help civilians in the crisis of famine for its own military objectives. In 1984, the estimated death toll from starvation because of famine and other factors rose to 300,000 (Keller, 1992). In time, the government acknowledged the crisis but developed an agenda that intentionally did not benefit the citizens of Ethiopia. The government planned to remove people from rural areas by force to camps and villages in supposed order to give them better access to social services. In reality, the government wanted to convert the resettlement communities into food production locations to support their operations and to serve their military recruitment needs. The areas that the people were resettled to lacked food, medical supplies and shelter. As foreign relief aid arrived it was sabotaged, diverted or bought and then sold to the refugees it was originally intended to go to for free (Keller, 1992). Through the history of the Ethiopian famine in these years, it is evident that the famine was in some ways a man-made famine and that it would elicit similar physical and behavioral responses observed in other populations.

Results: Comparing Physical and Behavioral Responses in Two Populations

In comparing the Warsaw Ghetto and famine prone African regions some data based information will be discussed but primary and secondary accounts will be used to illustrate the
models of the Minnesota starvation study and the presented supplemental literature. It is important to note that while the responses of the body, the individual and the population to starvation or famine can follow a model, the experiences and responses of residents in the Warsaw Ghetto and of citizens of the African regions experiencing starvation were compounded with the added stresses of threat, loss and a chaotic lifestyle (Ryn, 1990). This distinction makes the experiences of any group of subjects or populations no more or less; it is, however, a perspective that allows us to understand the influences and circumstances under which people starve.

*Physical Response*

Tushnet (1966) describes the physical responses of the residents studied in the Warsaw Ghetto Hunger Project in progressive phases and here the same method of organization will be employed. In phase one it was common for the person to experience dry mouth, increased urination (despite the fact that water supply was limited) and rapid loss of weight. As these symptoms lessened, weight loss slowed and hunger sensations became dulled (Tushnet, 1966), a shift occurred that can be explained by the fasting model discussed earlier and the process of ketosis. At this point the individual’s body had started to depend upon ketone body production to meet the glucose needs of the brain (Whitney and Rady Rolfes, 2005). Phase two symptoms began to appear with general weaknesses, an inability to carry out simple tasks, to sleep and to keep warm were common. Weight at this point was twenty to fifty percent less than pre-war and pre-internment weight. Later in phase two these symptoms were accompanied by bloody dysentery and fluid accumulation (edema) causing swelling all throughout the body. In phase three the skin was described as pale and thinned and of having a texture similar to parchment paper. Skin infections were common and symptoms of acne and dandruff, both conditions
caused and controlled by the sebaceous glands, disappeared. Slowed neuromuscular reaction was observed in many of the starving residents, however hearing and equilibrium remained undisturbed. Dental caries were common and often were so painful that chewing food became impossible. The vital capacity of the lungs was lowered and the frequency of respiration (frequency of breaths) was lowered to eleven to twelve per minute versus a normal respiration rate of eighteen to twenty per minute (Tushnet, 1966). This change in respiration rate likely occurred because the body was slowing down and in an attempt to conserve energy began reducing its normal functions. Other systems, such as the endocrine system, which controls hormone levels in men and women, shut down causing women to cease menstruating and men to become impotent.

When the Minnesota starvation study model is laid in comparison to the observations in the Warsaw Ghetto there are several similarities and differences. The more detrimental symptoms (bloody dysentery, weight loss up to fifty percent) can be explained by the difference in the caloric intake. The Minnesota study subjects during the semi-starvation period were receiving an average of 1,570 calories in relation to the resident of the Warsaw Ghetto’s three hundred. Further, the foods consumed in the Minnesota study were more complete with proteins, carbohydrates and fats than the watery soups and horse meat of the ghetto. The subjects in the Minnesota study were not exposed to harsh weather conditions, lice and other unsanitary environments. This difference explains the variance in rate of skin infection and skin condition between the Minnesota study subjects and the Warsaw Ghetto residents. Both subjects in the Minnesota study and the Hunger Project experienced feelings of being cold and lowered internal temperature because of soft tissue loss.
There is little information available about the physical and biological response of West African regions to famine other than to say that the symptoms likely matched those described in the fasting model and that disease rate and spread of infectious disease was high. The lack of data is likely due to the low status and lack of medical care in the rural areas that famine influenced most directly. In addition, these areas received little help from relief agencies. Even in areas of Ethiopia where government forced resettlement occurred and there would have been great opportunity for controlled study by the government or by relief agencies, the priority of the government was not to conduct such studies on health and wellness, but instead to continue depriving the people.

**Behavioral Responses**

Shipton’s (1990) prevention and remedy strategies will be used to discuss the behavioral responses of the Warsaw Ghetto and West African populations.

**Prevention Strategies**

1) Diversification of livelihood and resources.

In Sudan, coping strategies included eating wild foods and seeds (De Waal, 1991). This is one of the differences between the conditions present in West Africa and those in the Warsaw Ghetto. The residents of the ghetto had no way to set up, grow or sustain a garden or wild foods unless seed and needed supplies were smuggled in. Further, they did not have the time to wait for the food to grow and often would not have been in the ghetto long enough to reap the benefits of growing food. In addition, the soil of the ghetto was likely barren and activity of this nature would have been forbidden by Nazi decree.

Shipton (1990) discusses some preventative tactics in response to predicted onset of famine in West African regions: rotating crops and pastures, planting draught resistant crops and
working to accumulate a large herd of cattle so that the herd would sustain the individual and their surrounding kin during times of famine. In these regions the people could recognize the characteristics of famine because they had seen it happen at other times. However, in Warsaw no one knew what to expect and little warning was given of the consolidation of Warsaw resulting in little opportunity to prepare.

2) Consolidation of savings into illiquid, indivisible, or incontestable forms.

No applicable accounts.

3) Social investment.

People responded to the conditions of starvation and famine in different ways, but often the initial response was for people to draw together and collectively move forward (Dirks et al., 1980). Elders, the leaders in most rural African areas, remembered past famines and the emergency food repertoires that they depended upon and they would pass them down to the next generation as oral history (Shipton, 1990). Over time, however, as anxiety built, resources became further limited and conditions worsened this sense of community in the villages of Ethiopia and other African regions and in the ghetto community began to break down and other families and groups and eventually other individuals became competitors. Ritual events and ceremonial pragmatic gifts ended with the start of famine and weddings and payments were delayed (Shipton, 1990). There are undocumented accounts of substitution for ritual events, such as birthday’s, in the Warsaw Ghetto. Birthday cakes were made out of potato peels and molasses or jams were smuggled in. These accounts are likely true because it is evident that there was no easy way to maintain the previous way of life or convictions about food when resources that once were a large part of cultural rituals (birthdays, holidays, etc.) were scarce and virtually nonexistent. In Africa groups attempted to maintain friendships and relationships with other
distant groups so that in times of need they would be supported (Shipton, 1990). In the Warsaw Ghetto, however, all outside relief from individuals and organizations was cut off in December of 1941. Anything that was sent into or out of the Ghetto was confiscated by the Nazi regime and used for unknown and undocumented purposes.

**Remedy Strategies**

1) Liquidation: converting inedible capital assets into edible ones.

For many, work outside of the ghetto walls allowed them to exchange household items that they brought from the ghetto in exchange for food (Ofer, 2006). This was a rarity and work available outside of the walls decreased as time elapsed. In less severe cases of famine there are accounts of selling and stealing items in markets and in private dwellings (Shipton, 1990). In the Warsaw Ghetto a group of residents, mostly children, became *Khappers*. *Khappers* stole packages and food out of people’s hands and devoured it so quickly that the original owner had no chance of retrieving it. The *khapper* would run away quickly to avoid the inevitable beating they would receive (Tushnet, 1966). In some instances in West Africa children were sold or prostituted and in many cases adults became engaged in prostitution although this only fueled the spread of infectious disease and caused permanent social structure collapse (Shipton, 1990).

2) Service labor (wage labor and clientage or asymmetric interpersonal dependencies).

No applicable accounts.

3) Movement and migration.

In Ethiopian rural areas people sought to escape after being forcibly removed from their homes and taken to resettlement camps and villages. Some walked fifty miles during the initial period of relief center development to get food. They would take what they could for their families, but people in need of medical help were not able to walk to or access these facilities
and often starved or died from lack of needed supplies and resources (Keller, 1992). In one instance during the mass liquidation of the Warsaw Ghetto a sign was posted in the ghetto that announced if people went to the train station, where unbeknownst to them the cattle cars were being loaded to send to the Treblinka death camp, they would be relocated to a better place and they would get extra food. Needless to say, the food never came but hundreds appeared and were loaded onto the train and taken to Treblinka (Tushnet, 1966). The people were desperate for food and even more desperate to be relocated to better conditions. This is an example of Seaton’s (1962) theory that hungry populations will begin to submit and seek the control and stability that the ruling power potentially offers.

Discussion

There are a few ways in which the populations do not fit the models of the Minnesota study, the model of fasting or Shipton’s (1990) prevention and remedy strategies. These include the difference seen in number of cavities and the response of the skin to starvation between the Minnesota study subjects and those in the Warsaw Ghetto. This can be accounted for by the difference in environment, trauma, and caloric intake. In the fasting model one of the responses observed is a lessening of hunger sensations and the reduced need to search for food. In the Warsaw Ghetto there is never any mention of a reduced desire to find food. However, this is not to say that with the reduced energy production in the body that people did not reduce their attempts to find food in order conserve energy. There are accounts of prisoners in the concentration and extermination camps creating recipes, becoming obsessed with food and having dreams of food (Ryn, 1990) as was seen in subjects of the Minnesota study. However, this response is not documented in the Warsaw Ghetto but it can be assumed that it may have occurred. Two parts of Shipton’s (1990) model do not have any applicable accounts from either
population discussed: consolidation of savings and service labor. The rural populations of West
African likely had little that they could consolidate and the residents of the Warsaw Ghetto had
nearly all goods taken from them as consolidation of Warsaw occurred. Service labor may have
occurred in both areas, but again there are no clear accounts.

The limits of the data included the lack of physical response accounts for famine in the
West African countries discussed. However, this imbalance can be explained by the
circumstances of lacking health care and the goals of the government, which were not to conduct
studies on the health and wellness of the people there. The fact that the Hunger Project was
conducted in the Warsaw Ghetto and the manuscripts from it are available to us is by pure
chance. These sorts of activities were forbidden by Nazi decree and the smuggling of the data
out of Warsaw was risky and success was statistically unlikely as very little (people, relief, etc.)
were moved throughout Europe without coming under surveillance.

Conclusion

In an effort to comparatively examine physical and behavioral responses to starvation and
famine in two populations it can be concluded that in many ways the residents of the Warsaw
Ghetto and the citizens of famine prone West African areas fit the models of starvation and
exhibit similar patterns. While other factors contributed to the starvation and famine of the
populations, those man-made factors such as forced resettlement and threat were combined
effectively with inaccessibility to resources, which eventually produced starvation in both
populations.

Suggestions for further research

Further work with different demographics (age, gender, rural versus urban living) in
correlation with the occurrence of famine in Africa would help to evaluate whether or not
improvements in government planning have occurred and whether response strategies have been effective amongst different groups. Some studies exist on this subject, however, continued focus on it may help other regions in the world who are facing changes in weather patterns affecting agricultural practices coupled with unstable social structures to prepare and thrive despite decreasing food resources.

In terms of the Warsaw Ghetto, a focus on relative conditions in concentration camps and the varying caloric needs would be an interesting investigation. This is not to say that in the concentration camps the needs were better met. If anything they were less so, but to account for working conditions in labor camps versus camps where one was simply trying to survive versus conditions of the Warsaw Ghetto where much of daily life was spent sedentarily could perhaps contribute to our understanding of conditions in developing countries where people work long hours without breaks or adequate nutrition.
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Figure 1. Map of Warsaw, Poland and location of the Warsaw Ghetto.

Figure 2. Map of Sudan, Ethiopia and the West African Sahel Region.

Adapted from: http://z.about.com/d/worldnews/1/7/U/1/-/-/sudan_map.jpg.