Hutterites of North America and the Effects of Their Genetic Heritage
The Hutterite community provides an important role in the understanding of genetics and inheritability. Their unique history of forced migrations combined with their belief structure has resulted in a pronounced founder effect. The studying of Hutterite genetics has lead to a number of breakthroughs in genetic identification as well as increased understanding of unusual diseases. The consequences of the Hutterite search for freedom are felt in the communities of today.

The Hutterites trace their roots back to Tyrol in the 16th century. They are named after their Anabaptist leader, Jakob Hutter. He brought strong leadership to his group of previously fragmented Anabaptist followers as well as forging communal groups with practical regulations and organizational structure (Hutterites). The communities were called colonies or "Bruderhof". His group found biblical basis for establishing communal living distinguishing them from the two other Anabaptist groups, the Amish and Mennonites (Hutterite). Sharing both spiritual and material things within a community allows them to faithfully enact the central command of Scripture which is to love God and neighbor (Hutterites). Hutterites also practice adult baptism following confession of faith and have a strong belief in nonviolence (Hutterites).

One of the core beliefs of Hutterites is absolute pacifism which caused conflicts with their surrounding countrymen. This belief includes forbidding the taking of any part of military activities, wearing a formal uniform (including a soldier's or a police officer's), contributing war taxes, and swearing oaths (Hutterite). Local intolerance of the Hutterites lead to a series of migrations first from Tyrol, after the execution of Jakob Hutter, to Moravia. Once in Moravia, the Hutterites population expanded for over a century. Between 1529 and 1621, 102 Bruderhofs developed in Moravia with an estimated population of 20 to 30 thousand inhabitants (Hostetler 29). Then the Thirty Years' War broke out in Central Europe, including Moravia, which lead to the eventual destruction of numerous Hutterite Bruderhofs. The community continued to decline until 1622 when 7000 Hutterites were expelled after refusing to convert to Catholicism (Kats and Lehr 17).
From Monrovia the group relocated to Slovakia leaving behind all of their stores of wheat, rye, corn, and wine as well as their cattle, linen, woolens, equipment, and furniture (Hostetler 67). There they continued to suffer through thefts from neighbors and starvation due to troops destroying crops and land. The Hutterites came under intense pressure to convert to Catholicism as they were forced to sit through Catholic services, ministers were arrested, and children removed from their homes. Their numbers continued to decline to about 1000 as they moved from Slovakia to Transylvania (Kats and Lehr 17). Religious persecution again intensified so that by 1767, the remaining 67 Hutterites were forced to leave Transylvania and resettle near Romania (Kats and Lehr 18). In 1769 the war between Russia and the Ottoman Empire destroyed their settlement. At the suggestion of a Russian count, the group migrated to the Ukraine. Initially they were granted freedom of worship and exemption from military service (Kats and Lehr 19). The Hutterites worked hard at establishing a new colony and they began to grow once again. By the 1860's the government began enacting new laws establishing compulsory military service, government supervision of schools, and mandatory study of the Russian language making life in Ukraine intolerable for the Hutterites (Hostetler 29).

The need for freedom to live out their religious beliefs inspired the immigration of over 1200 Hutterites to South Dakota. The Hutterites settled into three colonies in South Dakota that continued the communal living arrangements as they previously did in the Ukraine. Even though 1200 left the Ukraine, only 443 people chose to live communally as the rest chose to settle on separate homesteads as "Prairieleut". Initially three communal farms were formed called: Schmeidleut (S-leut) of Bon Homme, Dariusleut (D-leut) of Wolf Creek, and Lehrleut (L-leut) of Elm Spring (Hutterites). Each colony acts as a large self-sufficient prairie farm. As a colony grows, it splits into mother and daughter colonies which are located near enough to encourage exchange of services but far enough to reduce friction (Hostetler and Bowker). In each colony there is a central kitchen and long houses with 3-room family apartments, as well as a kindergarten, school buildings,
sheds and barns. Housing units are assigned to individual families but belong to the colony. The entire colony eats lunch and dinner meals together in a dining room where the men and women sit in a segregated fashion (Hutterite).

The history of the Hutterites makes them especially well-suited for genetic research as they are socially isolated with little genetic inflow. Few individuals have joined the three Leuts since their formation in South Dakota in the 1870's and their population has grown from the original 443 to over 40,000 due to the importance of large families (Hutterite). Marriages are usually within the same Leut but not necessarily the same colony. The average Hutterite husband and wife are very closely related and people having the 14 most common family surnames account for 97% of the Hutterites (Hostetler and Huntington 139).

The founder effect is demonstrated in the Hutterites by showing that this small ethnic group is heavily influenced by the genetic makeup of a very small number of founding mothers and fathers (Hostetler and Huntington 139). In a 2009, there was a study of collected DNA of 31 South Dakota Hutterite colonies. It analyzed mitochondrial DNA (mtDNA) which is passed through the maternal line and the Y-chromosome which is passed through the paternal line. The study found 11 distinct types of mtDNA (called haplogroups) and only 10 distinct Y-chromosome haplogroups. This demonstrates that the Hutterites' ancestral maternal and paternal lines trace back to just 21 individuals (Pichler et al. 468). This is an extremely small number of founders and provides genetic evidence of large drops in the Hutterite population size over centuries just as the historical information suggests as well. In a small population, such as the Hutterites, genetic drift occurs when one version of a gene can displace all other existing versions of the same gene in just a few generations (Hostetler and Huntington 119). The founder effect is one example of genetic drift. As a population bottlenecks to a small number during a calamity and then expands during prosperity, its gene pool becomes an amplified version of those few individuals who survived the disaster. If this
version of the gene contains an abnormality, then the group has an increased risk of children born with this disease. New genetic variations are limited to coming into the community as the Hutterites marry within their own group leading to a greater likelihood that the recessive genes of the founders will come together in the subsequent offspring. This results in disease of recessive genes that show up more frequently than they would if the population married outside the group. The founder effect results in reduced genetic variation due to the small number of people who established the Hutterites.

The study of the Hutterite population has allowed for the characterization as well as the identification of mutations in a number of genetic conditions. First for this to occur, the group must have a well-maintained genetic record. For the Hutterites of South Dakota, these records are contained in The First Church Book and The Second Church Book. The First Church Book holds birth and death records from 1756-1843, Baptism records from 1762-1878, and marriages from 1763-1871 (Hofer and Walter 5). The Second Church Book contains birth and death records from 1844-1879 and marriages from 1872-187 (Hofer and Walter 5). These records establish the founder population. The S-leut Hutterites are descendents of 64 Hutterite ancestors that established the initial colony who now live in nine colonies in South Dakota. This small number of ancestral genomes facilitates the search for genes (Ober and Cox 1393). Second, the genetic studies need to control environmental risk factors. Again the Hutterites make an exceptional group to study as they maintain their traditional lifestyle. They eat the same food, have similar educations levels and have similar environmental exposures. As the environmental risk factors are controlled, the focus can be on the genetic variant.

There are a number of diseases and conditions that are caused by both genetic and environmental risk factors. Asthma is one of these complex genetic diseases. A recent study completed genetic studies on samples from 1200 Hutterites from S-leut colonies as they have a 13-
generation pedigree. In this study, they were able to identify a deletion in a gene that is associated with severe inflammation and mucus accumulation in the lungs which are markers for the diagnosis of asthma (Whole gene sequencing). Ongoing studies are now looking into using this gene for earlier identification of asthma patients not only in Hutterites but community wide (Ober and Cox 1397).

Another complex genetic disease is hypertriglyceridemia which is an important risk factor for cardiovascular disease. Previous studies of genome scans were unable to identify any significant areas on chromosomes linked to this condition. The S-leut colonies again were studied due to their extensive ancestral records. Due to their communal lifestyle, the test subjects also had essentially the same high-fat, high-cholesterol diet. In this group, areas on chromosomes 2 and 9 were associated with low triglyceride levels (Newman 141). Further studies are needed to identify the implications of these findings for screenings and offer the potential of developing new medicines. The relatively small number of founders and extreme genetic ancestries facilitate the search for human disease genes and pave the way for future treatment of common diseases such as asthma and hypertriglyceridemia.

There are a number of relatively unusual genetic conditions which are more common in the Hutterite population which has allowed these mutations to be identified specifically. Hutterites have an increased genetic propensity for cystic fibrosis (CF) compared to average American. CF is a genetic disorder that primarily affects the lungs but also the pancreas, liver, kidneys, and intestine leading to extreme breathing difficulties and a shortened life-span. CF is inherited in an autosomal recessive manner meaning that both parents must pass a copy of the gene to their child. A person receives one gene from their mother and one from their father. In recessive diseases, the disorder only occurs if the person inherits the same defective gene for the trait from each parent. If an individual receives one normal gene and one abnormal gene, the person is only a carrier for the gene and will not show any symptoms. In a couple where both are carriers of a recessive gene there is a
25% chance the child will inherit the disorder. There is a 50% chance the child will be a carrier and a 25% chance the will be have 2 copies of the normal gene. The risk remains the same for each pregnancy. Only 2 mutations of the CF gene (CFTR) are present in the Hutterites (Zilenski, Fujiwara, Markiewicz et al. 610). M1101K is the more common mutation and deltaF508 is less frequent. The M1101K mutation is also present in CF families in the Tyrol region which is the area that Jakob Hutter began his group. This shared mutation suggests that at least one founder from the Tyrol region introduced this mutation into the Hutterite population (Stuhrman, Fruhwirth, et al. 245). Owing to the founder effect, 82% of the CF mutations in South Dakota are this mutation (Gallego and Ober 580). This Tyrolean founder's mutation carries on today affecting families in South Dakota.

The identification of genes benefits families as well as the larger community. The direct benefits to the patients and their families include noninvasive diagnostic testing, carrier testing that can occur prior to marriage, prenatal testing, and enhancing understanding of the disease which facilitates management and treatment. There is a benefit as well to the larger population as many of these disorders are not limited to one genetic group. Gene identification allows accelerated diagnosis of atypical cases in the general population which allows for accurate treatment and management. Advances in this area also expand knowledge of basic science and clinical applications.

The Hutterites provide a valuable role in genetic studies due to their traditions of living communally, marrying within their ethnic group, and the valuing of large families in combination with their detailed genealogical records. The persecution of them due to their religious beliefs forced them to migrate multiple times through Europe and eventually to South Dakota. These moves created bottlenecks and expansions of their population resulting in a founder effect in their genes causing genetic propensity towards certain genetic conditions. Genes of the founders become disproportionately frequent in their population group compared to the outside community. Scientific
study of the Hutterites and their genes has advanced current understanding and medical treatment of disease around the world. The Hutterites are truly a people with their history etched in their genes.
Bibliography


