Additional file 4: Alignment of cloned *Ace-1* sequences from two G/S heterozygote (C11 and C12; diagnosed by TaqMan) and from direct sequencing of Taqman SS homozygote samples from the present study and from a previous collection from Madina (Accra) in 2008.

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C11A                            GACGCGGTCTGACGAGGCGCGAGTCAAACTCGGGTAAGTACGCGATTGGA 50
C11B                            GACGCGGTCTGACGAGGCGCGAGTCAAACTCGGGTAAGTACGCGATTGGA 50
C11C                            GACGCGGTCTGACGAGGCGCGAGTCAAACTCGGGTAAGTACGCGATTGGA 50
C12A                            GACGCGGTCTGACGAGGCGCGAGTCAAACTCGGGTAAGTACGCGATTGGA 50
C12B                            GACGCGGTCTGACGAGGCGCGAGTCAAACTCGGGTAAGTACGCGATTGGA 50
C12C                            GACGCGGTCTGACGAGGCGCGAGTCAAACTCGGGTAAGTACGCGATTGGA 50
Madina_2008_Ser_homozygote      GACGCGGTCTGACGAGGCGCGAGTCAAACTCGGGTAAGTACGCGATTGGA 50
Direct_seq_Ser_homozygotes      GACGCGGTCTGACGAGGCGCGAGTCAAACTCGGGTAAGTACGCGATTGGA 50
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C11A                            AGTGGGGGGACGTTTACCCTACCGTGTACTACAACGCACTTTACCCCCAC 100
C11B                            AGTGGGGGGACGTTTACCCTACCGTGTACTACAACGCACTTTACCCCCAC 100
C11C                            AGTGGGGGGACGTTTACCCTACCGTGTACTACAACGCACTTTACCCCCAC 100
C12A                            AGTGGGGGGACGTTTACCCTACCGTGTACTACAACGCACTTTACCCCCAC 100
C12B                            AGTGGGGGGACGTTTACCCTACCGTGTACTACAACGCACTTTACCCCCAC 100
C12C                            AGTGGGGGGACGTTTACCCTACCGTGTACTACAACGCACTTTACCCCCAC 100
Madina_2008_Ser_homozygote      AGTGGGGGGACGTTTACCCTACCGTGTACTACAACGCACTTTACCCCCAC 100
Direct_seq_Ser_homozygotes      AGTGGGGGGACGTTTACCCTACCGTGTACTACAACGCACTTTACCCCCAC 100
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C11A                            GCACACGCACCGGCAGACGCGAACGACAACGATCCGCTGGTGGTCAACAC 150
C11B                            GCACACGCACCGGCAGACGCGAACGACAACGATCCGCTGGTGGTCAACAC 150
C11C                            GCACACGCACCGGCAGACGCGAACGACAACGATCCGCTGGTGGTCAACAC 150
C12A                            GCACACGCACCGGCAGACGCGAACGACAACGATCCGCTGGTGGTCAACAC 150
C12B                            GCACACGCACCGGCAGACGCGAACGACAACGATCCGCTGGTGGTCAACAC 150
C12C                            GCACACGCACCGGCAGACGCGAACGACAACGATCCGCTGGTGGTCAACAC 150
Madina_2008_Ser_homozygote      GCACACGCACCGGCAGACGCGAACGACAACGATCCGCTGGTGGTCAACAC 150
Direct_seq_Ser_homozygotes      GCACACGCACCGGCAGACGCGAACGACAACGATCCGCTGGTGGTCAACAC 150
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C11A                            GGATAAGGGGCGCATCCGCGGCATTACGGTCGATGCGCCCAGCGGCAAGA 200
C11B                            GGATAAGGGGCGCATCCGCGGCATTACGGTCGATGCGCCCAGCGGCAAGA 200
C11C                            GGATAAGGGGCGCATCCGCGGCATTACGGTCGATGCGCCCAGCGGCAAGA 200
C12A                            GGATAAGGGGCGCATCCGCGGCATTACGGTCGATGCGCCCAGCGGCAAGA 200
C12B                            GGATAAGGGGCGCATCCGCGGCATTACGGTCGATGCGCCCAGCGGCAAGA 200
C12C                            GGATAAGGGGCGCATCCGCGGCATTACGGTCGATGCGCCCAGCGGCAAGA 200
Madina_2008_Ser_homozygote      GGATAAGGGGCGCATCCGCGGCATTACGGTCGATGCGCCCAGCGGCAAGA 200
Direct_seq_Ser_homozygotes      GGATAAGGGGCGCATCCGCGGCATTACGGTCGATGCGCCCAGCGGCAAGA 200
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C11A                            AGGTGGACGTGTGGCTCGGCATTCCCTACGCCCAGCCGCCGGTCGGGCCG 250
C11B                            AGGTGGACGTGTGGCTCGGCATTCCCTACGCCCAGCCGCCGGTCGGGCCG 250
C11C                            AGGTGGACGTGTGGCTCGGCATTCCCTACGCCCAGCCGCCGGTCGGGCCG 250
C12A                            AGGTGGACGTGTGGCTCGGCATTCCCTACGCCCAGCCGCCGGTCGGGCCG 250
C12B                            AGGTGGACGTGTGGCTCGGCATTCCCTACGCCCAGCCGCCGGTCGGGCCG 250
C12C                            AGGTGGACGTGTGGCTCGGCATTCCCTACGCCCAGCCGCCGGTCGGGCCG 250
Madina_2008_Ser_homozygote      AGGTGGACGTGTGGCTCGGCATTCCCTACGCCCAGCCGCCGGTCGGGCCG 250
Direct_seq_Ser_homozygotes      AGGTGGACGTGTGGCTCGGCATTCCCTACGCCCAGCCGCCGGTCGGGCCG 250
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C11A                            CTACGGTTCCGTCATCCGCGGCCGGCCGAAAAGTGGACCGGCGTGCTGAA 300
C11B                            CTACGGTTCCGTCATCCGCGGCCGGCCGAAAAGTGGACCGGCGTGCTGAA 300
C11C                            CTACGGTTCCGTCATCCGCGGCCGGCCGAAAAGTGGACCGGCGTGCTGAA 300
C12A                            CTACGGTTCCGTCATCCGCGGCCGGCCGAAAAGTGGACCGGCGTGCTGAA 300
C12B                            CTACGGTTCCGTCATCCGCGGCCGGCCGAAAAGTGGACCGGCGTGCTGAA 300
C12C                            CTACGGTTCCGTCATCCGCGGCCGGCCGAAAAGTGGACCGGCGTGCTGAA 300
Madina_2008_Ser_homozygote      CTACGGTTCCGTCATCCGCGGCCGGCCGAAAAGTGGACCGGCGTGCTGAA 300
Direct_seq_Ser_homozygotes      CTACGGTTCCGTCATCCGCGGCCGGCCGAAAAGTGGACCGGCGTGCTGAA 300
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C11A                            CACGACCACACCGCCCAACAGCTGCGTGCAGATCGTGGACACCGTGTTCG 350
C11B                            CACGACCACACCGCCCAACAGCTGCGTGCAGATCGTGGACACCGTGTTCG 350
C11C                            CACGACCACACCGCCCAACAGCTGCGTGCAGATCGTGGACACCGTGTTCG 350
C12A                            CACGACCACACCGCCCAACAGCTGCGTGCAGATCGTGGACACCGTGTTCG 350
C12B                            CACGACCACACCGCCCAACAGCTGCGTGCAGATCGTGGACACCGTGTTCG 350
C12C                            CACGACCACACCGCCCAACAGCTGCGTGCAGGTCGTGGACACCGTGTTCG 350
Madina_2008_Ser_homozygote      CACGACCACACCGCCCAACAGCTGCGTGCAGATCGTGGACACCGTGTTCG 350
Direct_seq_Ser_homozygotes      CACGACCACACCGCCCAACAGCTGCGTGCAGATCGTGGACACCGTGTTCG 350
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C11A                            GCGACTTCCCGGGCGCGACCATGTGGAACCCGAACACGCCCCTGTCCGAG 400
C11B                            GCGACTTCCCGGGCGCGACCATGTGGAACCCGAACACGCCCCTGTCCGAG 400
C11C                            GCGACTTCCCGGGCGCGACCATGTGGAACCCGAACACGCCCCTGTCCGAG 400
C12A                            GCGACTTCCCGGGCGCGACCATGTGGAACCCGAACACGCCCCTGTCCGAG 400
C12B                            GCGACTTCCCGGGCGCGACCATGTGGAACCCGAACACGCCCCTGTCCGAG 400
C12C                            GCGACTTCCCGGGCGCGACCATGTGGAACCCGAACACGCCCCTGTCCGAG 400
Madina_2008_Ser_homozygote      GCGACTTCCCGGGCGCGACCATGTGGAACCCGAACACGCCCCTGTCCGAG 400
Direct_seq_Ser_homozygotes      GCGACTTCCCGGGCGCGACCATGTGGAACCCGAACACGCCCCTGTCCGAG 400
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C11A                            GACTGTCTGTACATTAACGTGGTGGCACCGCGGCCCCGGCCCAAGAATGC 450
C11B                            GACTGTCTGTACATTAACGTGGTGGCACCGCGGCCCCGGCCCAAGAATGC 450
C11C                            GACTGTCTGTACATTAACGTGGTGGCACCGCGGCCCCGGCCCAAGAATGC 450
C12A                            GACTGTCTGTACATTAACGTGGTGGCACCGCGGCCCCGGCCCAAGAATGC 450
C12B                            GACTGTCTGTACATTAACGTGGTGGCACCGCGGCCCCGGCCCAAGAATGC 450
C12C                            GACTGTCTGTACATTAACGTGGTGGCACCGCGGCCCCGGCCCAAGAATGC 450
Madina_2008_Ser_homozygote      GACTGTCTGTACATTAACGTGGTGGCACCGCGGCCCCGGCCCAAGAATGC 450
Direct_seq_Ser_homozygotes      GACTGTCTGTACATTAACGTGGTGGCACCGCGGCCCCGGCCCAAGAATGC 450
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C11A                            GGCCGTCATGCTGTGGATCTTCGGCGGCAGCTTCTACTCCGGCACCGCCA 500
C11B                            GGCCGTCATGCTGTGGATCTTCGGCGGCAGCTTCTACTCCGGCACCGCCA 500
C11C                            GGCCGTCATGCTGTGGATCTTCGGCGGCAGCTTCTACTCCGGCACCGCCA 500
C12A                            GGCCGTCATGCTGTGGATCTTCGGCGGCAGCTTCTACTCCGGCACCGCCA 500
C12B                            GGCCGTCATGCTGTGGATCTTCGGCGGCAGCTTCTACTCCGGCACCGCCA 500
C12C                            GGCCGTCATGCTGTGGATCTTCGGCGGCAGCTTCTACTCCGGCACCGCCA 500
Madina_2008_Ser_homozygote      GGCCGTCATGCTGTGGATCTTCGGCGGCAGCTTCTACTCCGGCACCGCCA 500
Direct_seq_Ser_homozygotes      GGCCGTCATGCTGTGGATCTTCGGCGGCAGCTTCTACTCCGGCACCGCCA 500
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C11A                            CCCTGGACGTGTACGACCACCGGGCGCTTGCGTCGGAGGAGAACGTGATC 550
C11B                            CCCTGGACGTGTACGACCACCGGGCGCTTGCGTCGGAGGAGAACGTGATC 550
C11C                            CCCTGGACGTGTACGACCACCGGGCGCTTGCGTCGGAGGAGAACGTGATC 550
C12A                            CCCTGGACGTGTACGACCACCGGGCGCTTGCGTCGGAGGAGAACGTGATC 550
C12B                            CCCTGGACGTGTACGACCACCGGGCGCTTGCGTCGGAGGAGAACGTGATC 550
C12C                            CCCTGGACGTGTACGACCACCGGGCGCTTGCGTCGGAGGAGAACGTGATC 550
Madina_2008_Ser_homozygote      CCCTGGACGTGTACGACCACCGGGCGCTTGCGTCGGAGGAGAACGTGATC 550
Direct_seq_Ser_homozygotes      CCCTGGACGTGTACGACCACCGGGCGCTTGCGTCGGAGGAGAACGTGATC 550
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C11A                            GTGGTGTCGCTGCAGTACCGCGTGGCCAGTCTGGGCTTCCTGTTTCTCGG 600
C11B                            GTGGTGTCGCTGCAGTACCGCGTGGCCAGTCTGGGCTTCCTGTTTCTCGG 600
C11C                            GTGGTGTCGCTGCAGTACCGCGTGGCCAGTCTGGGCTTCCTGTTTCTCGG 600
C12A                            GTGGTGTCGCTGCAGTACCGCGTGGCCAGTCTGGGCTTCCTGTTTCTCGG 600
C12B                            GTGGTGTCGCTGCAGTACCGCGTGGCCAGTCTGGGCTTCCTGTTTCTCGG 600
C12C                            GTGGTGTCGCTGCAGTACCGCGTGGCCAGTCTGGGCTTCCTGTTTCTCGG 600
Madina_2008_Ser_homozygote      GTGGTGTCGCTGCAGTACCGCGTGGCCAGTCTGGGCTTCCTGTTTCTCGG 600
Direct_seq_Ser_homozygotes      GTGGTGTCGCTGCAGTACCGCGTGGCCAGTCTGGGCTTCCTGTTTCTCGG 600
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C11A                            CACCCCCGAAGCGCCGGGCAATGCGGGACTGTTCGATCAGAACCTTGCGC 650
C11B                            CACCCCCGAAGCGCCGGGCAATGCGGGACTGTTCGATCAGAACCTTGCGC 650
C11C                            CACCCCCGAAGCGCCGGGCAATGCGGGACTGTTCGATCAGAACCTTGCGC 650
C12A                            CACCCCCGAAGCGCCGGGCAATGCGGGACTGTTCGATCAGAACCTTGCGC 650
C12B                            CACCCCCGAAGCGCCGGGCAATGCGGGACTGTTCGATCAGAACCTTGCGC 650
C12C                            CACCCCCGAAGCGCCGGGCAATGCGGGACTGTTCGATCAGAACCTTGCGC 650
Madina_2008_Ser_homozygote      CACCCCCGAAGCGCCGGGCAATGCGGGACTGTTCGATCAGAACCTTGCGC 650
Direct_seq_Ser_homozygotes      CACCCCCGAAGCGCCGGGCAATGCGGGACTGTTCGATCAGAACCTTGCGC 650
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C11A                            TACGGTAGGTGTCTTTGCGTGTGTGTCTGTAGTTATAGTATTCTAACGAG 700
C11B                            TACGGTAGGTGTCTTTGCGTGTGTGTCTGTAGTTATAGTATTCTAACGAG 700
C11C                            TACGGTAGGTGTCTTTGCGTGTGTGTCTGTAGTTATAGTATTCTAACGAG 700
C12A                            TACGGTAGGTGTCTTTGCATGTGTGAGTGAGGCTTTAGTATTCTAACGAG 700
C12B                            TACGGTAGGTGTCTTTGCGTGTGTGTCTGTAGTTATAGTATTCTAACGAG 700
C12C                            TACGGTAGGTGTCTTTGCGTGTGTGTCTGTAGTTATAGTATTCTAACGAG 700
Madina_2008_Ser_homozygote      TACGGTAGGTGTCTTTGCGTGTGTGTCTGTAGTTATAGTATTCTAACGAG 700
Direct_seq_Ser_homozygotes      TACGGTAGGTGTCTTTGCGTGTGTGTCTGTAGTTATAGTATTCTAACGAG 700
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C11A                            GTGCTCTTCTTCCCATCACTTCTTGGGAGTCAGCTGGGTGCGGG 744
C11B                            GTGCTCTTCTTCCCATCACTTCTTGGGAGTCAGCTGGGTGCGGG 744
C11C                            GTGCTCTTCTTCCCATCACTTCTTGGGAGTCAGCTGGGTGCGGG 744
C12A                            GTGCTCTTCTTCCCATCACTTCTCGGGAGTCAGCTGGGTGCGGG 744
C12B                            GTGCTCTTCTTCCCATCACTTCTTGGGAGTCAGCTGGGTGCGGG 744
C12C                            GTGCTCTTCTTCCCATCACTTCTTGGGAGTCAGCTGGGTGCGGG 744
Madina_2008_Ser_homozygote      GTGCTCTTCTTCCCATCACTTCTTGGGAGTCAGCTGGGTGCGGG 744
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Direct_seq_Ser_homozygotes      GTGCTCTTCTTCCCATCACTTCTTGGGAGTCAGCTGGGTGCGGG 744
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